

**Commonwealth of Virginia  
Department of Environmental Quality**

**Virginia Mercury Study**

**Proposal (RFP № 07-03-JW)**

**November 10, 2006**

06-098



**Passion. Expertise. Results.**

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**Commonwealth of Virginia Department of  
Environmental Quality**

**Virginia Mercury Study**

**Proposal (RFP № 07-03-JW)**

**November 10, 2006**

**Prepared for**

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## RFP Cover Sheet (Section IV.B.1)

In Compliance With This Request For Proposal And To All The Conditions Imposed Therein And Hereby Incorporated By Reference, The Undersigned Offers And Agrees To Furnish The Goods/Services In Accordance With The Attached Signed Proposal Or As Mutually Agreed Upon By Subsequent Negotiation.

Name And Address Of Firm:

Date: \_\_\_\_\_

ICF Resources, LLC

By: \_\_\_\_\_  
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## RFP Addendum No. 1 Acknowledgment Sheet (Section IV.B.1)

By signature below, we also acknowledge receipt of Addendum No. 1 of the RFP, which was issued by Virginia DEQ on 23 October 2006.

ICF Resources, LLC

*Name of Firm*

*Signature/Title*

*Date*

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# Table of Contents

RFP Cover Sheet (Section IV.B.1).....	i
RFP Addendum No. 1 Acknowledgment Sheet (Section IV.B.1) .....	i
<b>1. Introduction (RFP, Section I).....</b>	<b>1</b>
Background (RFP, Section II) .....	1
Objectives (RFP, Section II).....	2
Highlights of the Experience and Qualifications of the Project Team (RFP, Section V.B) .....	3
Highlights of the Technical Approach (RFP, Section III.A, III.B) .....	4
<b>2. Technical Approach (RFP, Sections IV.B.4, V.B.2) .....</b>	<b>7</b>
Mercury Emissions Data Analysis (RFP, Section III.A).....	7
<i>Understanding the Objectives and Requirements of the Mercury Emissions Data Analysis .....</i>	<i>7</i>
<i>Task 1: Air Point Source Mercury Emissions Inventory Review.....</i>	<i>7</i>
<i>Task 2: Mercury Emission Inventory Summary.....</i>	<i>9</i>
<i>Task 3: Literature Review.....</i>	<i>14</i>
<i>Task 4: Mercury Emissions Data Analysis Report .....</i>	<i>14</i>
<i>Task 5: Data Archival and Transfer of Inventory Files .....</i>	<i>14</i>
<i>Task 6: Quality Assurance Plan .....</i>	<i>14</i>
<i>Task 7: Project Management .....</i>	<i>15</i>
<i>Task 8: Other Tasks Not Assigned.....</i>	<i>15</i>
Mercury Deposition Modeling (RFP, Section III.B).....	16
<i>Understanding the Objectives and Requirements of the Modeling Study .....</i>	<i>16</i>
<i>Task 1: Conceptual Model.....</i>	<i>17</i>
<i>Task 2: Modeling Protocol.....</i>	<i>20</i>
<i>Task 3: Model Sensitivity Analysis .....</i>	<i>21</i>
<i>Task 4: Model Performance Evaluation.....</i>	<i>25</i>
<i>Task 5: Modeling Simulations .....</i>	<i>28</i>
<i>Task 6: Mercury Deposition Modeling Report.....</i>	<i>31</i>
<i>Task 7: Data Archival and Transfer of Inventory Files .....</i>	<i>31</i>
<i>Task 8: Quality Assurance Plan .....</i>	<i>31</i>
<i>Task 9: Project Management .....</i>	<i>32</i>
<i>Task 10: Other Tasks Not Assigned .....</i>	<i>32</i>
<b>3. Qualifications and Experience of the Project Team (RFP, Sections IV.B.3, V.B.1) .....</b>	<b>33</b>
Overview of the Project Team.....	33
Summary of Education and Experience of Proposed Personnel .....	35
Qualifications and Roles/Responsibilities of Core Project Participants.....	36
<b>4. Schedule and Deliverables (RFP Sections IV.B.4, V.B.2) .....</b>	<b>43</b>
Schedule .....	43
Deliverables .....	44
<i>Part A—Mercury Emissions Data Analysis.....</i>	<i>44</i>
<i>Part B—Mercury Deposition Modeling .....</i>	<i>44</i>
<b>5. Client Reference Form and Past Performance Summaries (RFP Section IV.B.2, Attachment D).....</b>	<b>45</b>
Attachment D: Vendor Data Sheet.....	45
<b>6. Pricing Schedule .....</b>	<b>65</b>
<b>7. SWAM Utilization (Attachment G).....</b>	<b>67</b>
Attachment G: Participation in SWAM .....	67

8. References.....	69
9. Appendix: Resumes.....	71

## List of Figures

Figure 2-1. Comparison of Spatial Distribution of Low-Level Mercury Emissions (tons) for the 2001 CAMR Emissions Inventory for the 36-km Grid for a Summer Weekday: All Species.....	11
Figure 2-2a. Spatial Distribution of Low-Level Mercury Emissions (tons) for the 2001 CAMR Emissions Inventory for the 36-km Grid for a Summer Weekday: All Species.....	13
Figure 2-2b. Spatial Distribution of Elevated Point-Source Mercury Emissions (tons) for the 2001 CAMR Emissions Inventory for the 36-km Grid for a Summer Weekday: All Species.....	13
Figure 2-3. Summary of Mercury Tagging Results for Chickahominy Lake, Virginia.....	19
Figure 2-4. Summary of Mercury Tagging Results for the Great Dismal Swamp, Virginia.....	20
Figure 2-5. CMAQ 36- and 12-km Nested-Grid Modeling Domain.....	23
Figure 2-6. Monthly Average Rainfall amount (in) Based on Observed and Simulated Daily Precipitation Values (2001).....	23
Figure 2-7. Example CMAQ PPTM Mercury Tagging Results for June 2001: Dry Deposition ( $\text{g km}^{-2}$ ).....	27
Figure 2-8. Simulated and Observed Annual Total Wet Deposition of Mercury for 2001.....	27
Figure 2-9. Example CMAQ PPTM Mercury Tagging Results for June 2001: Contribution to Mercury Deposition from EGU Sources ( $\text{g km}^{-2}$ ).....	30
Figure 4-1. Proposed schedule for completing Parts A and B of the Virginia Mercury Study (shading represents ongoing activity).....	43
Figure 5-1. VISTAS Meteorological and Visibility Characterization Tool.....	60
Figure 5-2. UAM-V Modeling Domain for the Gulf Coast Ozone Study (GCOS), with 36, 12, 4 and 2-km Resolution Nested Grids.....	61
Figure 5-3. UAM-V Modeling Domain for the Arkansas-Tennessee-Mississippi Ozone Study (ATMOS), with 36-, 12- and 4-km Resolution Nested Grids.....	63

## List of Tables

Table 2-1a. Top Five Point Source Divalent Mercury Emitters for Virginia for 2001.....	8
Table 2-1b. Top Five Point Source Elemental Mercury Emitters for Virginia for 2001.....	9
Table 2-2. Summary of Mercury Emissions (tpy) for Virginia from Non-point Sources for 2001.....	10
Table 3-1. Summary of Education, Years of Experience, and Number of Projects for Areas Relevant to the Virginia Mercury Study for Key ICF Project Personnel.....	35

# 1. Introduction (RFP, Section I)

In response to the Request for Proposal (RFP) #07-03-JW, ICF is pleased to submit the following proposal to assist the Virginia Department of Environmental Quality (VDEQ) in conducting the Virginia Mercury Study. Our proposal addresses the mercury emissions data analysis and mercury deposition modeling activities outlined in Sections A and B of the Statement of Needs section of the RFP. We are currently completing a national- and regional-scale mercury emissions data analysis, modeling emissions inventory processing, and deposition modeling study for the EPA Office of Water (OW) and will integrate and build on the results of this recent study to enhance our work for VDEQ. For the proposed study, we propose to utilize the services of two Virginia DMBE certified businesses: LPES, Inc., of Smithfield, VA, a small business enterprise, and Thruput, of Saltville, VA, a woman-owned business enterprise. (RFP, Section I)

## Background (RFP, Section II)

Human exposure to mercury is most commonly associated with the consumption of contaminated fish. Due to measured high levels of mercury in fish, at least 44 U.S. states have, in recent years, issued fish consumption advisories. These advisories may suggest limits on the consumption of certain types of fish or they may recommend limiting or not eating fish from certain bodies of water because of unsafe levels of mercury contamination. States have identified more than 6,000 individual bodies of water as mercury impaired and have issued mercury fish advisories for more than 2,000 individual bodies of water. (RFP, Section II, paragraph 3)

Until 2002, significant mercury contamination in Virginia surface waters was known only in three rivers (the North Fork of the Holston River, the South River, and the South Fork Shenandoah River) with historical industrial releases. Since then, however, state monitoring efforts have identified mercury contamination in a number of surface waters without readily identifiable sources. (RFP, Section II, paragraph 5)

Virginia expanded its mercury monitoring in 2002 based on an increasing scientific understanding of mercury's environmental chemistry and discoveries in other states (e.g., Florida, Maryland) of mercury pollution in water bodies without direct sources. The 2002 monitoring effort focused on rivers of the coastal plain, mostly to the east of I-95. As a result of this effort, Virginia found elevated mercury levels in some fish in the Blackwater River, the Great Dismal Swamp Canal, the Dragon Run Swamp, and the Piankatank River. Consistent with findings from Florida and elsewhere, these water bodies in Virginia possess characteristics favorable for the formation of the highly bio-accumulative form of mercury, methyl mercury. These characteristics include low dissolved oxygen, high organic matter, and low pH, and are most prevalent in "backwaters" of the southeastern portion of the state. (RFP, Section II, paragraph 5)

The primary source of mercury to these water bodies is suspected to be atmospheric deposition. There are currently three Mercury Deposition Network (MDN) sites located in Virginia, in Shenandoah National Park, Culpeper, and Harcum and data from these sites have contributed to the regional characterization of mercury transport and deposition throughout the state. Additional monitoring at the Harcum site in 2005 revealed that dry deposition of reactive gaseous (divalent) mercury along the Piankatank River (near the Chesapeake Bay) and in upstream areas is an important contributor to the high mercury levels observed in the water and fish in the area. (RFP, Section II, paragraph 4)

Global, regional, and local sources of air mercury emissions contribute to the deposition, and understanding these contributions is an important step toward identifying measures that will effectively reduce mercury deposition and environmental mercury levels. (RPF, Section II, paragraph 1)

## Objectives (RFP, Section II)

This study includes a detailed analysis of mercury emissions inventory data, as well as a comprehensive mercury deposition modeling analysis. Both the data analysis and modeling components are intended to examine and quantify the contribution of regional and local emissions sources to mercury deposition throughout the Commonwealth, and to provide information to support the further analysis of the impact of mercury deposition on the environment. (RPF, Section II, paragraph 2)

For each of the bodies of water listed as impaired by Virginia, the Clean Water Act calls for the calculation of a Total Maximum Daily Load (TMDL). TMDLs identify the pollutant reductions or limits that are needed in order to achieve water quality standards. TMDLs must also allocate the reductions to the different sources of pollution, including air sources. Thus another key objective of the data and modeling analyses is to provide information that will enable VDEQ to conduct TMDL studies. (RPF, Section II, paragraph 6)

Finally, the results of this study will also be used to support VDEQ's evaluation of potential measures needed to reduce mercury emissions in Virginia. Specifically, the proposed data and modeling analysis studies will allow VDEQ to evaluate the effectiveness of selected control measures and support the development of management strategies for meeting water quality criteria and protecting human health. (RPF, Section II, paragraph 2)

The reliability of the mercury deposition assessments, including the modeling, will depend significantly on the quality and completeness of the emission inventory data. Thus, a key objective of the emissions data analysis component of the study will be to assess and improve, as needed, the reliability of the mercury emissions data. The data analysis focuses on the review and refinement of the mercury emissions data from a variety of source categories, which include coal-fired utilities, medical waste incinerators, and municipal waste incinerators. The emissions data analysis also requires the reliable projection of these data to three future years, accounting for the requirements of the Virginia General Assembly Bill that limits participation by sources located in Virginia in the mercury emissions federal trading program. (RPF, Section I)

The modeling analysis includes the development of a conceptual description of mercury deposition, which will improve the overall understanding of the mercury problem and the relationships between meteorology and mercury deposition. The modeling results will provide a basis for quantifying the contribution of emissions sources to mercury deposition and examining the fate of mercury emissions from selected sources. For environmental planning purposes, the modeling will be used to examine the effectiveness of control measures in reducing mercury concentrations in contaminated bodies of water and improving or maintaining water quality within the designated areas of interest in Virginia. By quantifying deposition, the modeling results will also provide a link between the analysis of mercury emissions and the assessment of the impacts of airborne mercury on fish tissue and human health. (RPF, Section I)

On the project management side, our objectives are to develop and implement a sound program management plan that supports and ensures our ability to 1) deliver high quality technical services within the proposed schedule and budget, and 2) address any problems that arise during the course of the study in a prompt, responsible manner. Other requirements include several meetings, conference

calls, and monthly written progress reports. Our approach to meeting these requirements and fulfilling the objectives of the study is provided in Sections 2 and 3 of this proposal. (RFP, Sections III.A and III.B)

## **Highlights of the Experience and Qualifications of the Project Team (RFP, Section V.B)**

The proposed project team is experienced in the analysis of mercury emissions data and the development and application of modeling techniques for mercury deposition, including mercury contribution analysis. This experience is summarized in Section 3 of the proposal and further substantiated by the numerous project summaries included in Section 5. (RPF, Section V.B)

Our work in the area of mercury emissions data analysis provides us with an excellent basis for reviewing and updating the emissions inventory, with the added benefit that we have just recently reviewed, updated, processed, and conducted deposition modeling using the EPA's latest version of the national mercury emissions inventory. This work was conducted during the past year and represents our latest and most comprehensive achievement in this area, but our experience spans several years. Several of the ICF project team members have been involved in the review, analysis, and processing of mercury emissions at the national, state, and facility level since approximately 1997, working with and helping to update each successive version of the national emissions inventory for mercury. The focus of much of our mercury emissions data analysis work has been the development of emissions inventories for mercury deposition modeling, using a variety of emissions processing and modeling tools. Based on this experience, we are very familiar with the format and content of the emissions datasets and also recognize the importance of the underlying emissions inventory data to the success of a modeling study. Members of the proposed project team have been involved in the development of the Integrated Planning Model (IPM) and its application for the 2005 Clean Air Mercury Rule (CAMR) and other national emission reduction programs. ICF team members also recently supported EPA in the risk assessment design for CAMR, conducting literature searches and assembling data on the toxicology of mercury and human health routes of exposure. (RPF, Section V.B)

The scientists on our proposed project team offer a detailed, state-of-the-science theoretical grasp of mercury chemistry and the processes that contribute to the transformation, transport deposition, and re-emission of mercury in the atmosphere. We have designed and conducted data analysis studies to improve our understanding of the relationships between mercury deposition and meteorology, using statistical analysis techniques (such as Classification and Regression Tree (CART) analysis) as our probe for revealing these relationships. We have also used our understanding of the relationships between meteorology and mercury transport/deposition to assess the suitability of annual periods for mercury deposition modeling. The insights gained from these prior studies will be applied to the development of the conceptual model for mercury deposition for Virginia. (RPF, Section V.B)

Our knowledge of mercury chemistry, transport, and deposition has also been enhanced through our work in mercury deposition modeling. ICF scientists developed the REgional Modeling System for Aerosols and Deposition (REMSAD) which incorporates state-of-the-science mercury chemistry and deposition processes. Identifying and quantifying the global, regional, and local contributions to mercury deposition and, more specifically, the sources of air mercury emissions is key to identifying measures that will effectively reduce mercury deposition and environmental mercury levels. With this in mind, ICF scientists have also developed a

mercury tagging methodology that is designed to provide detailed, quantitative information about the contribution of selected sources, source categories, and/or source regions to simulated mercury concentrations and (wet and dry) deposition. Mercury emissions from selected sources, source categories, or source regions are (numerically) tagged and then tracked throughout a simulation, and the contribution from each tag to the resulting simulated concentration or deposition for any given location can be quantified. By tracking the emissions from selected sources or source locations, the methodology also provides information on the fate of the emissions from these sources. Mercury tagging is one element of the Particle and Precursor Tagging Methodology (PPTM). ICF first developed and incorporated PPTM into REMSAD, and has recently (at the request of EPA) incorporated PPTM into the CMAQ model. The principal developer of REMSAD and the developer of PPTM, Tom Myers, will be a key participant in the VDEQ project. (RPF, Section V.B)

We have conducted more than six comprehensive mercury deposition modeling studies. These have included national as well as regional studies; the more regional studies have focused on Devil's Lake, Wisconsin, coastal Louisiana, and the Chesapeake Bay area. Our most recent mercury modeling study includes the tracking (tagging) of more than 300 sources throughout the U.S., including several sources in Virginia. This study, conducted for the EPA Office of Water (OW), also included a detailed review, analysis, and update of EPA's latest mercury emission inventory. We will use this EPA OW study as a starting point for the Virginia mercury deposition modeling and will draw on the information and databases, as appropriate, to enhance the reliability of the results and our cost effectiveness and ability to meet the schedule for the proposed VDEQ study. (RPF, Section V.B)

The success of ICF's mercury modeling studies, and the use of our data analysis and modeling results by EPA and others, speak to our ability to combine good science, innovative data analysis methods, and available emissions data to produce useful, informative, reliable, and high quality mercury deposition analyses for our clients. (RPF, Section V.B)

## **Highlights of the Technical Approach (RFP, Section III.A, III.B)**

Our technical approach will build on our experience in conducting similar analyses. For the mercury emissions data analysis and the subsequent mercury deposition modeling, we will utilize an updated version of the latest national-scale mercury emission inventory prepared by EPA. We recently updated this inventory as part of our work for the EPA OW, and will further update it based on survey information for Virginia for 2002 and 2005. We will use state-of-the-science emissions processing and projection tools (such as SMOKE and IPM) and will work closely with VDEQ to ensure that all projection factors and growth and control assumptions are reasonable. (RPF, Section III.A)

In conducting the deposition modeling, we will utilize both regional-scale and local modeling tools in order to examine and characterize the different factors and types of emissions sources contributing to mercury deposition in Virginia. We propose to use the CMAQ regional-scale model with PPTM to quantify the global, national, and regional contributions to mercury deposition. In addition, we propose to use the AERMOD Gaussian dispersion model, as needed, to quantify the impacts of local sources on a given body of water or hydrologic zone. We will use these same tools to project future mercury deposition amounts and assess the effectiveness of mercury emission reduction measures on mercury deposition for "impaired" water bodies and other areas of interest. (RPF, Section III.B)

Our technical approach has several important attributes including:

- Use of CART and existing modeling results to probe the relationships between mercury deposition and meteorology and further develop our understanding of the characteristics of mercury deposition in Virginia. (RPF, Section III.B, Task 1)
- Assessment of model performance using actual and estimated mercury deposition data, drawing on geographical and meteorological relationships to estimate the deposition for unmonitored areas in Virginia for the base year. (RPF, Section III.B, Task 4)
- Use of CMAQ PPTM source contribution analysis to quantify contributions from a variety of global, national, and regional sources and to track the fate of emissions from key sources in Virginia. (RPF, Section III.B, Task 5)
- Use of combined regional- and local-scale modeling methods to capture and quantify the contributions and effects of emission reductions for a variety of scales. (RPF, Section III.B, Task 5)
- Our ability to draw on existing modeling results for Virginia and other areas to add to the overall quality, timeliness, and robustness of the study. (RPF, Section V.B)

In summary, we offer an innovative and scientifically sound technical approach combined with an experienced project team in the areas of mercury emissions data analysis and deposition modeling. (RPF, Sections III.A and III.B)

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## **2. Technical Approach (RFP, Sections IV.B.4, V.B.2)**

In this section, we provide our proposed technical approach for conducting all of the tasks included in Sections A (Mercury Emissions Data Analysis), and B (Mercury Deposition Modeling) of the Virginia Mercury Study.

### **Mercury Emissions Data Analysis (RFP, Section III.A)**

In the following, we provide details about our proposed approach for conducting the tasks under Section A of the RFP in reviewing the available mercury emissions inventory for Virginia and surrounding areas. The information derived from this task will be used to update the emission inventory that will be used in the subsequent modeling exercise called for under Section B of the RFP.

#### ***Understanding the Objectives and Requirements of the Mercury Emissions Data Analysis***

For this study, the Commonwealth of Virginia is seeking assistance in quantifying current and future estimates of mercury deposition throughout the state as the result of emissions from sources located within the state, in surrounding states, within the continental U.S., and as part of the global background. Mercury deposition to land areas and waterways within the state is a result of emissions from a combination of these sources. For this analysis, estimations of base year deposition throughout the state will be provided with the application of air quality models using historical emission estimates as input. Future year deposition estimates will be provided by the air quality models using projected emission estimates. In order to gain a clear understanding as to which sources contribute to mercury deposition throughout the state, it is imperative to use the best set of base-year emissions estimates for Virginia (and surrounding state) sources, because future-year deposition estimates will rely on the integrity of the base-year values and the accuracy of forecasted industrial activity. (RFP, Section III.A)

The objective of Part A of the overall study is to review the existing mercury emissions inventory for Virginia and surrounding areas, and to improve these estimates for the designated base year so that the most current information can be used in the mercury deposition modeling section of the study. (RFP, Section III.A)

#### ***Task 1: Air Point Source Mercury Emissions Inventory Review***

In this task, we will acquire, review, and summarize mercury emissions estimates provided by Virginia DEQ. These estimates are based on the recent source-specific survey of statewide sources. VDEQ solicited on the order of 75 specific sources for updated mercury emission estimates for 2002 and 2005, although they may not have received the requested information from all solicited sources. Of those that provided updated information, some sources prepared emissions estimates based on measurements (stack tests), while others based their estimates on standard process-based emission factors for various source types (e.g., AP-42). Still others may have estimated emissions using alternative methods. For each facility for which we are provided information, we will conduct a thorough technical review of the emissions estimates, taking into account the important factors that affect mercury emissions such as process-type, boiler-type, fuel type, equipment-type, and stack parameters (e.g., flow rate, exit temperature, exit velocity, etc.). For each facility, we will assess the accuracy of the emission estimates and review all of the facility-specific information including location, stack parameters, hours of

operation, maintenance schedules, and estimated diurnal operating profiles. We will also investigate whether any emission control or other equipment was installed or replaced between 2002 and 2005 and whether the facility is planning to change/update equipment in the near future. If new control or other equipment will be installed beyond 2005, this will be accounted for in the future-year emission estimates to be provided in Task 2 for 2010, 2015, and 2018. (RFP, Section III.A, Task 1)

As a starting point in our review and evaluation of sources outside Virginia, we will utilize existing emissions estimates derived from current national-scale mercury emission inventories prepared by EPA. We are currently working with a 2001 inventory for our ongoing EPA OW mercury deposition work. For the modeling analysis tasks (discussed in the next section of the proposal), we plan to utilize the existing 2001 modeling database and update the Virginia mercury sources with 2002 data, as appropriate. Although the Virginia updates will be for 2002, we feel that combining the 2001 national-scale inventory with 2002 Virginia updates will provide the best mercury emission inventory for the base-year modeling, given the desire to leverage off of existing modeling databases and the constraints on the schedule. We have already refined the emissions for the Virginia sources, as part of our ongoing work for the EPA OW. Specifically, we prepared summaries of the emissions for each state, provided them to state and regional offices for review, and incorporated all of the updates and corrections that we received into the inventory. The updates for 2002 will be a further refinement. We will use the improved 2001/2002 inventory for the Virginia mercury modeling analysis. (RFP, Section III.A, Task 1)

Table 2-1 presents emissions data for the top five point source emitters of both divalent and elemental mercury in Virginia for 2001 as contained in the currently available national inventory we are using for our EPA OW mercury deposition modeling analysis (Myers et al., 2006). Although dominated by electric generation units/utilities, incineration and other sources are also potentially large emitters of elemental and divalent mercury in Virginia and in surrounding states. (RFP, Section III.A, Task 1)

**Table 2-1a. Top Five Point Source Divalent Mercury Emitters for Virginia for 2001.**

Facility Name	HG0 (Elemental) (tpy)	HG2 (Divalent) (tpy)	HGP (Particulate) (tpy)	Total (tpy)	Source Category
Chesterfield Power Station	0.047	0.125	0.011	0.184	Coal fired Utility
NASA Refuse-fired Steam Generator	0.025	0.066	0.023	0.114	Incineration
Chesapeake Energy Center	0.023	0.062	0.006	0.091	Coal fired Utility
Norfolk Navy Yard	0.021	0.056	0.019	0.097	Incineration
Clinch River	0.020	0.054	0.005	0.079	Coal fired Utility

**Table 2-1b. Top Five Point Source Elemental Mercury Emitters for Virginia for 2001.**

Facility Name	HG0 (Elemental) (tpy)	HG2 (Divalent) (tpy)	HGP (Particulate) (tpy)	Total (tpy)	Source Category
Jewel Coke Company LLP	0.135	0.017	0.017	0.169	Ferrous Metals Processing
Chaparral	0.112	0.014	0.014	0.140	Ferrous Metals Processing
Possum Point Power Station	0.017	0.044	0.004	0.065	Coal fired Utility
Bremo Power Station	0.024	0.037	0.003	0.063	Coal fired Utility
Stericycle Inc. (formerly American Waste)	0.003	0.044	0.012	0.058	Incineration (MWI)

The analyses conducted in this task will be summarized in a draft technical memo. The memo will include data sources, methods, results, and estimates of uncertainty and limitations. The memo will be revised in accordance with comments from VDEQ and will then be incorporated into the mercury emissions data analysis report, to be prepared as part of Task 4. (RFP, Section III.A, Task 1)

### ***Task 2: Mercury Emission Inventory Summary***

In this task, we will utilize the information gathered and reviewed as part of Task 1 to update the Virginia mercury emissions inventory. We will also summarize the information/data to be used in the modeling analysis to be conducted in Section B of the study. Any changes to be made to update the Virginia point sources will be reviewed and approved by VDEQ staff prior to use in the modeling analysis. The evaluations and summaries will be provided by applicable source categories, such as electric generation, material processing, etc. The summary will include the outcome from the review of the methods used in estimating mercury emissions including stack tests, standard process/unit-based emission factors, or other methods. A comprehensive summary will be provided for the base-year (2002/2005) emission inventories, which will provide the bases for the future-year estimates. (RFP, Section III.A, Task 2)

In addition to the point source information reviewed as part of Task 1, we will also review and summarize all other anthropogenic and geogenic sources of mercury emissions. Table 2-2 presents a summary of mercury emissions for Virginia for the non-point source categories as contained in the EPA's national-scale emission inventory for 2001. Although relatively small compared to emissions from the utilities and industrial point sources listed above, the table presents mercury emission estimates for other source categories located in Virginia that potentially contribute to mercury deposition within the state. Currently available emissions estimates for Virginia and nearby states for these categories will also be reviewed and summarized as part of this task. (RFP, Section III.A, Task 2)

Table 2-2. Summary of Mercury Emissions (tpy) for Virginia from Non-point Sources for 2001.

HG0 (Elemental) (tpy)	HG2 (Divalent) (tpy)	HGP (Particulate) (tpy)	Total (tpy)	Source Category Description
5.2E-04	3.1E-04	2.1E-04	0.001	Industrial: Distillate oil
1.3E-03	8.0E-04	5.3E-04	0.003	Industrial: Liquid waste
1.9E-05	2.3E-06	2.3E-06	0.000	Chemical Manufacturing
2.2E-06	0	0	2.2E-06	Electrical Equipment
0.017	0	0	0.017	Photo Equip/Health Care: Dental alloy production
0.023	0	0	0.023	Photo Equip/Health Care: Laboratories
0.001	3.8E-04	2.6E-04	0.001	Industrial: Residual oil
5.4E-05	3.3E-05	2.2E-05	0.000	Commercial/Institutional: Anthracite coal
3.9E-04	2.3E-04	1.6E-04	0.001	Commercial/Institutional: Bituminous coal
0.006	0.004	0.002	0.012	Commercial/Institutional: Distillate oil
3.4E-04	2.0E-04	1.3E-04	0.001	Commercial/Institutional: Residual oil
0.001	0.001	0.000	0.002	Commercial/Institutional: Wood
1.8E-05	1.1E-05	7.3E-06	0.000	Residential: Anthracite coal
0.001	4.8E-04	3.2E-04	0.002	Residential: Bituminous coal
0.022	0.013	0.009	0.043	Residential: Distillate oil
4.3E-04	0.001	3.9E-04	0.002	Other Combustion
0.020	0	0	0.020	Fluorescent Lamp Breakage

Figure 2-1 presents a comparison of elemental, divalent, and particulate mercury emissions for Virginia and surrounding states for 2001. This plot suggests that emissions from neighboring (and often upwind) states of Kentucky and West Virginia may also contribute to mercury deposition in Virginia's waterways.

**Figure 2-1. Comparison of Spatial Distribution of Low-Level Mercury Emissions (tons) for the 2001 CAMR Emissions Inventory for the 36-km Grid for a Summer Weekday: All Species.**

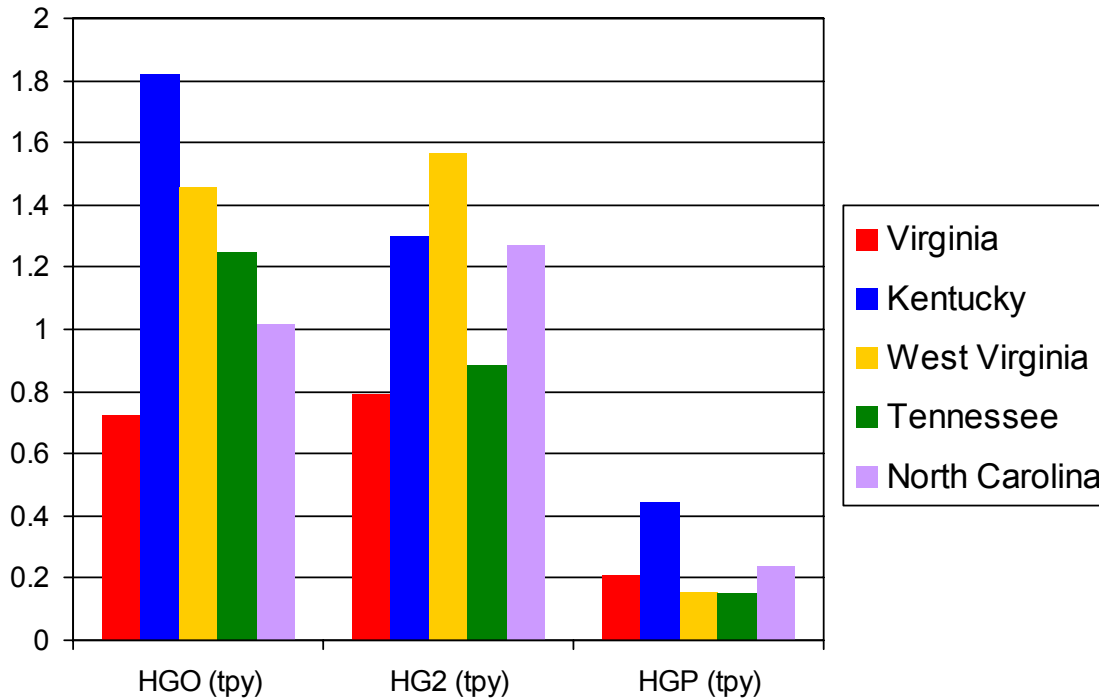


Figure 2-2a presents total low-level source mercury emissions for a summer weekday for the 2001 continental U.S. inventory being used in our current mercury deposition modeling exercise for the EPA OW. Figure 2-2b presents total mercury emissions for elevated point sources. For this analysis, we will focus on the Mid-Atlantic states in depicting the spatial distribution of low-level and elevated sources potentially affecting Virginia. (RFP, Section III.A, Task 2).

In this task, we will also prepare future-year estimates of mercury emissions for point and non-point sources in Virginia for 2010, 2015, and 2018. These estimates will take into account the provisions of CAMR and HB1055 on Virginia sources.

The CAMR, promulgated on May 18, 2005, includes two mechanisms to reduce mercury emissions from electric power plants. First, it sets standards of performance for new and existing coal-fired power plants. Second, it establishes a two-phase, national cap-and-trade program. In the initial phase of the cap-and-trade program, the national mercury emissions will be capped at 38 tons and emissions reductions will occur as a “co-benefit” of sulfur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>) emissions under the Clean Air Interstate Rule (CAIR) issued on March 10, 2005. In the second phase, due in 2018, coal-fired power plants will be subject to a second cap, which will reduce emissions to 15 tons upon full implementation. (RFP, Section III.B, Task 5, paragraphs 2 and 3)

To participate in the cap-and-trade program, states must submit to EPA a State Implementation Plan revision that describes how the state will meet its mercury reduction budget. States may adopt a “model rule” or a rule(s) with comparable provisions. Legislation enacted by Virginia in April 2006 authorized the Air Pollution Control Board to adopt and submit to EPA the model rule. As described below, the Virginia legislation also provided authority for state-specific rules to

further control mercury emissions from sources regulated under CAMR. These are summarized by the following amendments to the Code of Virginia:

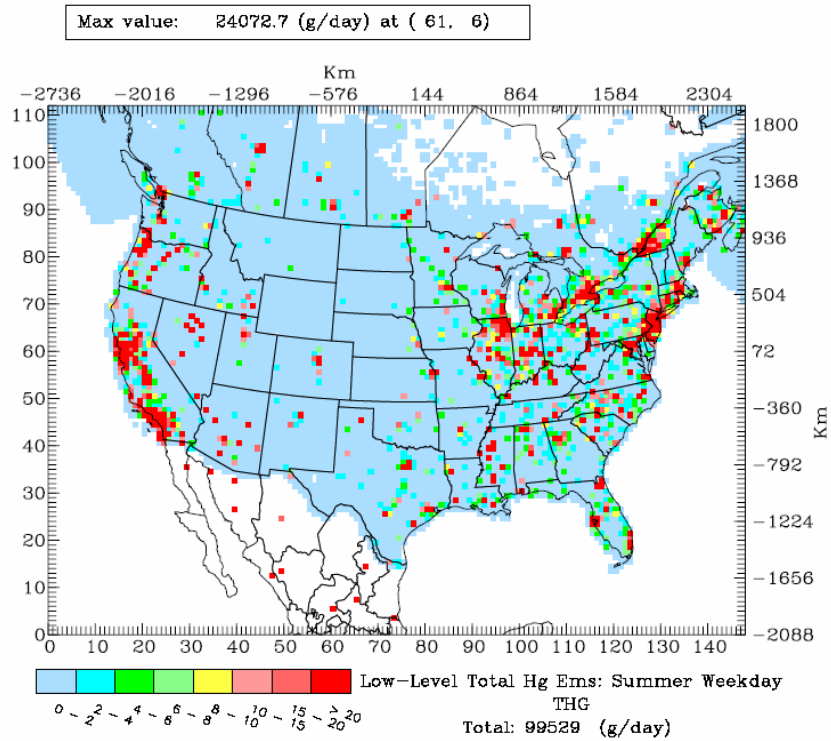
- § 10.1-1328 C – This section directs the Air Pollution Control Board to adopt and submit to EPA the CAMR “model rule” for participation in the federal mercury cap-and-trade trading program. The rule will include a set-aside of mercury allowances for new sources not to exceed 5 percent of the total state budget during the first five years and 2 percent thereafter.
- § 10.1-1328 D – This section is a state-specific (i.e., that exceeds the requirements of the CAMR rule) rule. Its requirements are similar to the CAMR cap-and-trade program, but it applies to additional (smaller) sources and includes additional restrictions on compliance options.
- § 10.1-1328 E – This section directs the Air Pollution Control Board to adopt regulations governing mercury emissions that meet, but do not exceed, the requirements and implementation timetables for (i) any coke oven batteries for which the EPA has promulgated standards under § 112(d) of the Clean Air Act, and (ii) facilities subject to review under § 112(k) of the Clean Air Act and that receive scrap metal from persons subject to § 46.2-635 of the Code of Virginia.
- § 10.1-1328 F – This section is a state-specific rule that prohibits electric generating facilities in nonattainment areas from meeting mercury compliance obligations by purchasing credits from other facilities. An exception applies when the facility owner can demonstrate compliance using allowances at another of its facilities within 200 kilometers of the Virginia boarder.

We will work with VDEQ in to translate these rules and provisions into emissions estimates and incorporate them into the future-year emission inventories, staging them as appropriate, for each future year. (RFP, Section III.A, Task 2)

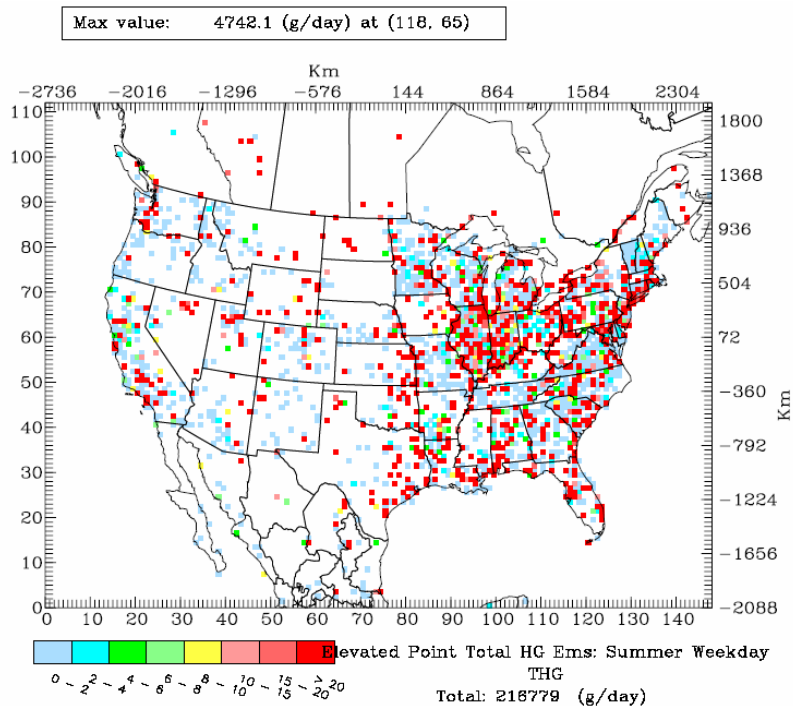
The work in this task will also include an analysis of expected emissions reductions, future-year trends for all source categories, and a comparison of Virginia emissions with neighboring states, regions, national, and global sources affecting Virginia. To the extent possible, we will utilize the latest available IPM outputs that have been prepared by ICF’s Energy group for EPA and others for national-scale emissions inventories. These estimates will accurately reflect the implementation timing and effects of the CAIR and CAMR emission reduction provisions. (RFP, Section III.A, Task 2)

The analyses conducted in this task will be summarized in a draft technical memo. The memo will include data sources, methods, results, and estimates of uncertainty and limitations. The draft memo will be revised based on comments from VDEQ and incorporated into the mercury emissions data analysis report, to be prepared as part of Task 4. (RFP, Section III.A, Task 2)

**Figure 2-2a. Spatial Distribution of Low-Level Mercury Emissions (tons) for the 2001 CAMR Emissions Inventory for the 36-km Grid for a Summer Weekday: All Species.**



**Figure 2-2b. Spatial Distribution of Elevated Point-Source Mercury Emissions (tons) for the 2001 CAMR Emissions Inventory for the 36-km Grid for a Summer Weekday: All Species.**



### ***Task 3: Literature Review***

As stated in Amendment No. 1 of the RFP, in this task we will conduct a literature review of recent research into “atmospheric chemistry and reactivity, mercury deposition mechanisms, and physical and chemical characteristics of mercury.” As part of this review, we will also review reports addressing mercury emissions issues, deposition modeling, and modeling studies conducted to estimate global background values of mercury. Estimates of global background vary widely in the current literature and outputs from various global models have been used in recent modeling studies as input for continental-scale mercury modeling studies. We will summarize the findings of these studies in a draft technical memo, which will include a complete list of data sources, references, journals, and web sites found as part of the review. The draft memo will be revised based on comments from VDEQ and incorporated into the mercury emissions data analysis report, to be prepared as part of Task 4. (RFP, Section III.A, Task 3)

### ***Task 4: Mercury Emissions Data Analysis Report***

In this task, based on information prepared as part of Tasks 1-3, we will prepare a comprehensive draft mercury emissions data analysis report. The report will incorporate the memos prepared for each of these tasks and all comments received from VDEQ. We will also include an Executive Summary. (RFP, Section III.A, Task 4.)

### ***Task 5: Data Archival and Transfer of Inventory Files***

All of the data, data files, and software required to corroborate the results and findings of the study will be provided to VDEQ in an approved electronic format. As noted in the RFP, we may utilize ftp methods for transfer of smaller files and will use portable disk drives for the transfer of larger files and/or the complete database. (RFP, Section III.A, Task 5)

### ***Task 6: Quality Assurance Plan***

We will prepare draft and final versions of a Quality Assurance Project Plan (QAPP) that will address all aspects of the technical effort covering both Sections A (emission inventory review/analysis) and Section B (mercury deposition modeling). The QAPP will include procedures for reviewing emission data, processing and use of air quality, meteorological, and emissions data, as well as the application of the modeling tools. The QAPP will be prepared in accordance with EPA requirements governing QAPP preparation. Its purpose will be to ensure that the emissions inventory and modeling study is scientifically sound and error free. The QAPP will address:

- Data acquisition (sources and procedures).
- Data quality assurance and processing procedures.
- Stepwise checking of each analysis component (emission inventory review, data analysis and processing, modeling emission inventory preparation, model application, postprocessing of the model outputs, display and analysis of the modeling results, and documentation).
- Internal and external review of all presentation materials and documentation.
- Communication and resolution of technical issues (in conjunction with VDEQ).

The QAPP will be prepared so that it will guide our technical work, as well as the quality assurance of data and modeling results once they are delivered to VDEQ. We will assign a quality assurance officer to each project task. This will be an individual who has a

comprehensive understanding of the task, but is not involved in the detailed technical work for that task. (RFP, Section III.A, Task 6)

A draft QAPP will be prepared and submitted to VDEQ for review at the beginning of the project. A revised QAPP will be prepared prior to the conclusion of the project, and finalized based on comments. (RFP, Section III.A, Task 6)

### ***Task 7: Project Management***

As discussed in Section 3 of the proposal document, the proposed project manager for the mercury deposition analysis is Mr. Jay Haney. Mr. Haney has more than 27 years of experience in the conduct and management of meteorological, emissions, and air quality data analysis and modeling studies. He is a Vice President with ICF International with the authority to utilize all of the resources of our firm to ensure the high quality, effective, timely, and efficient completion of the proposed study. As discussed in our capabilities statement, Mr. Haney has successfully managed more than 25 studies that are similar to the size and scope of the proposed effort. He will be responsible for the:

- Day-to-day management of all technical tasks.
- Technically sound and efficient completion of each task and the entire project.
- Communication with the VDEQ, including the exchange of ideas and information and prompt responses to questions from VDEQ.
- Development and refinement of the project scope of work in cooperation with VDEQ and other project participants
- Conformity with the modeling protocol and implementation of the QAPP
- Resolution of any technical and project-management-related issues.
- Quality and timeliness of all project deliverables.

As part of this task, Mr. Haney and other scientists from ICF will participate in biweekly (or as needed) conference calls and up to four one-day project meetings covering the emissions data analysis and modeling work. (RFP, Section III.A, Task 7, paragraphs 1 and 3)

During the first month of the project, ICF will prepare a work plan that includes the objectives, scope, budget, and schedule for each task. The work plan will be revised as needed during the course of the project to reflect progress to date and to ensure a successful completion of the project. (RFP, Section III.A, Task 7, paragraph 2)

Each month progress will be evaluated against this work plan and summarized in a written status report to VDEQ. The status reports will provide a detailed discussion of work accomplished during the report period, results achieved during the reporting period, problems encountered and how they were resolved, and planned activities for the next two months. The status report will also include a summary of expenditures for the period and cumulative expenditures for the project. (RFP, Section III.A, Task 7, paragraph 2)

### ***Task 8: Other Tasks Not Assigned***

Under this task, we will respond to any additional requests that VDEQ may have for work related to the review of the mercury emission inventory. We will be pleased to provide a scope

of work and cost estimate for any additional tasks that arise during the course of the study. (RFP, Section III.A, Task 8)

## **Mercury Deposition Modeling (RFP, Section III.B)**

In this section of the proposal we provide the technical approach for the mercury deposition modeling as outlined in Section III, B. of the RFP.

### ***Understanding the Objectives and Requirements of the Modeling Study***

The mercury deposition modeling is a key component of this study. It will provide for an improved understanding of the mercury issues in Virginia by quantifying the contribution of emissions sources to mercury deposition and examining the fate of mercury emissions from selected sources located within the Commonwealth. Once the modeling platform has been established and tested for the base year, it will be used to examine future-year scenarios and the effectiveness of control measures in reducing mercury deposition. The modeling will also provide quantitative estimates of deposition that will allow VDEQ to link the analysis of mercury emissions and the assessment of the impacts of airborne mercury on fish tissue and human health. The modeling analysis also includes the development of a conceptual description of mercury deposition, which will improve the overall understanding of the mercury problem and the relationships between meteorology and mercury deposition. (RPF, Section III.B)

Atmospheric modeling provides an analytic method for quantifying the contributions from sources of airborne mercury to mercury deposition. Regional-scale modeling is especially well suited to quantify the global, national, and regional contributions to mercury deposition in a given area. At the local scale, other methods such as high-resolution modeling or Gaussian modeling may be needed to quantify the impacts of local sources on a given body of water or hydrologic zone. (RPF, Section III.B)

For this study, we recommend a combination of grid-based regional-scale modeling and Gaussian modeling to examine the different factors and types of emissions sources contributing to mercury deposition in Virginia. For the regional-scale modeling, we propose to use the Community Multi-scale Air Quality (CMAQ) model and, in particular, the CMAQ Particle and Precursor Tagging Methodology (PPTM) to quantify source contributions and guide the control strategy assessment. PPTM allows one to track or tag mercury emissions from selected sources, and quantify their contribution to mercury deposition throughout a modeling domain and simulation period. We have used this approach in several recent studies to estimate the contribution to mercury deposition at selected locations throughout the U.S. from a variety of source regions, source categories, and individual sources. For example, we have used PPTM to estimate the contribution of boundary conditions, in-state versus out-of-state sources, and selected point sources of mercury air emissions to Devil's Lake, Wisconsin, the Chesapeake Bay, and selected areas in each of the contiguous 48 states. (RPF, Section III.B)

We recognize that regional, grid-based models, which are typically applied using 12- to 36-km horizontal grid resolution, may not be able to sufficiently resolve and simulate the effects of local sources on nearby bodies of water. Consequently, we also recommend the use of the AERMOD Gaussian modeling system – both as a screening tool to identify sources for PPTM and to help quantify local (sub-grid-scale) contributions and effects. (RFP, Section III.B)

The technical approach to each mercury deposition modeling task follows. (RFP, Section III.B)

### ***Task 1: Conceptual Model***

A “conceptual model” or “conceptual description” will be developed to characterize the key mercury deposition issues for Virginia in terms of geographic extent, severity, meteorological influences, and emissions sources. The key questions to be addressed in the conceptual description are listed in the RFP and include:

1. What are the specific meteorological parameters that influence mercury deposition in Virginia in the order of importance?
2. Is the mercury deposition problem primarily a local one, or are regional, national, and global factors important?
3. Are there any characteristic spatial patterns of mercury deposition?
4. Are there discernable trends in mercury deposition and are they accompanied by recent changes in emissions?
5. What past mercury modeling has been performed for Virginia and to what extent are the results consistent with the present study?

We will add the following questions to this list:

6. Are there any characteristic temporal (seasonal) patterns of mercury deposition?
7. To what extent are the trends in mercury deposition (from Question 4 above) associated with trends in meteorological conditions?
8. What do the results of recent mercury modeling of Virginia indicate regarding the relative importance of wet versus dry deposition, and regarding the species distribution of the deposition?

Our approach to the development of a conceptual description for mercury deposition will include analysis of mercury deposition, meteorological, and emissions data as well as examination of prior modeling results, with emphasis on the most recent national-scale mercury modeling analysis that we are currently completing for the EPA Office of Water (OW). (RFP, Section III.B, Task 1)

As a starting point in this analysis, we will assemble available mercury deposition data for sites in Virginia and several nearby and surrounding states (North Carolina, Tennessee, Kentucky, West Virginia, Pennsylvania, Maryland, Delaware, and New Jersey) for the period 2000-2005. This will include data from the Mercury Deposition Network (MDN) available from the National Acid Deposition Program (NADP) as well as any special studies that have been conducted. There are currently three MDN sites located in Virginia, in Shenandoah National Park, Culpeper, and Harcum. The period of record for the MDN data is late 2002 to present for the first two sites and approximately 2005 to present for the Harcum site. Each measurement of wet deposition represents a seven-day period. We will also assemble available meteorological data for surface and upper-air meteorological monitoring sites collocated with or near to the Virginia mercury monitoring sites, and will calculate meteorological summary parameters that describe the conditions over each seven-day period represented by the mercury observations. The summary parameters will include, for example, total rainfall, number of days with rainfall, maximum 24-hr rainfall, average daily maximum and minimum temperatures, average relative humidity, average wind speeds, frequency of occurrence of wind directions, and a recirculation index. We will

prepare graphical and tabular summaries that will provide an overview of the data and highlight key features/components of the datasets, such as the regional (site-to-site) differences in the seasonal and annual deposition values, corresponding seasonal and annual rainfall totals, and year-to-year variations in the deposition amounts and meteorological conditions. (RFP, Section III.B, Task 1)

As part of this task, we will use the Classification and Regression Tree (CART) analysis technique to probe the relationships between mercury deposition and meteorology. CART analysis (Brieman et al., 1984; Steinburg and Colla, 1997) is a statistical analysis tool that can be used to identify relationships between mercury deposition and meteorological parameters. CART accomplishes this through the development of a classification tree, in which the branches of the tree represent different types of meteorological conditions that lead to different values of mercury deposition. In constructing the classification tree, CART also determines the relative importance of the meteorological parameters to deposition. In addition, the frequency of occurrence of the conditions associated with each classification group (representing a deposition amount) can be determined. (RFP, Section III.B, Task 1)

In the context of this study, the CART results will be used to refine the conceptual description for mercury deposition for each monitoring site. CART will provide information on the different combinations of meteorological parameters that lead to different amounts of mercury deposition, the relative importance of the various meteorological parameters, and the frequency of occurrence of the conditions associated with each deposition classification group. (RFP, Section III.B, Task 1)

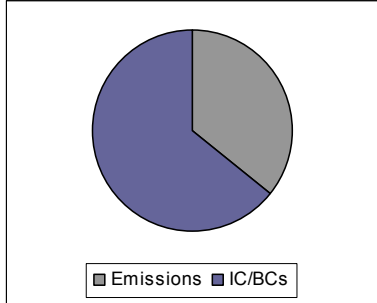
The CART results will also be used to examine and distinguish between the effects of meteorology and the effects of emissions changes on observed changes in mercury deposition. Year-to-year variations in observed mercury deposition amounts will be compared with year-to-year variations in the meteorological conditions (and specifically the frequency of occurrence of the different types of meteorological conditions affecting mercury deposition). We will account for the effects of meteorological variations before attempting to reconcile any trends in observed deposition amounts to changes in emissions. (RFP, Section III.B, Task 1)

We will also use existing modeling results to further develop our understanding of the characteristics of mercury deposition in Virginia. The ICF air quality modeling group is just completing a modeling study for the EPA OW involving the analysis and tracking of airborne mercury emissions (Myers et al., 2006). We have used the REMSAD modeling system along with the PPTM approach to tag and track emissions from approximately 300 sources throughout the contiguous 48 U.S. states and have examined the contribution of these emissions to mercury deposition in each state. We have also incorporated PPTM for mercury into the CMAQ model and as part of this study are comparing the REMSAD PPTM results with the CMAQ PPTM results. We will conduct some additional analysis of the results from the EPA-sponsored study to obtain preliminary model-based information on the spatial distribution of mercury deposition, the relative importance of wet versus dry deposition at the monitoring sites and within selected areas of interest in Virginia, the speciation characteristics of the simulated deposition, and the sources contribution to the simulated deposition. Some sample results summarizing the characteristics of and contributions to total annual mercury deposition for Chickahominy Lake and the Great Dismal Swamp are provided in Figures 2-3 and 2-4. (RFP, Section III.B, Task 1)

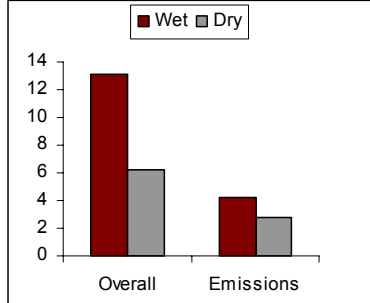
**Figure 2-3. Summary of Mercury Tagging Results for Chickahominy Lake, Virginia.**

*Simulated Annual Hg Deposition for 2001 for Chickahominy Lake (I=375, J=168): 21 kg/ha*

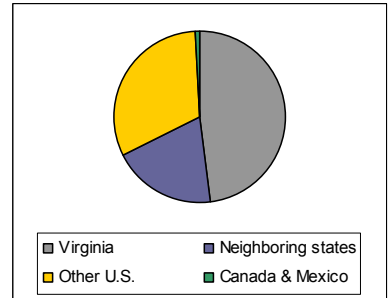
Emissions vs. IC/BC Contributions



Contribution by Wet & Dry Deposition (kg/ha)

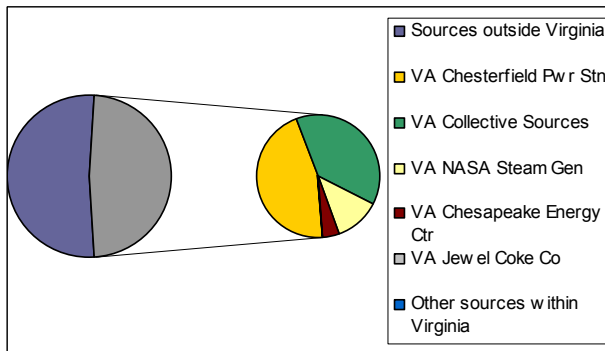


Emissions Contribution by Region

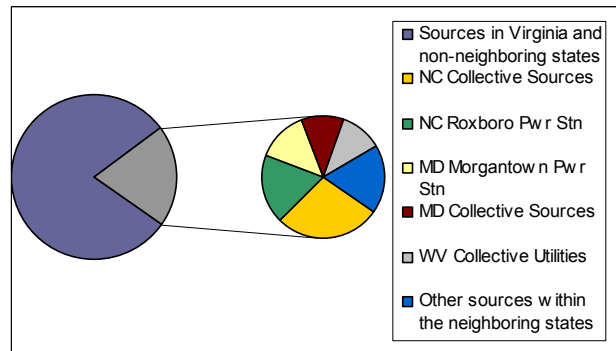


*Neighboring States: MD, DC, NC, WV, KY & TN*

Contributions from Virginia Sources



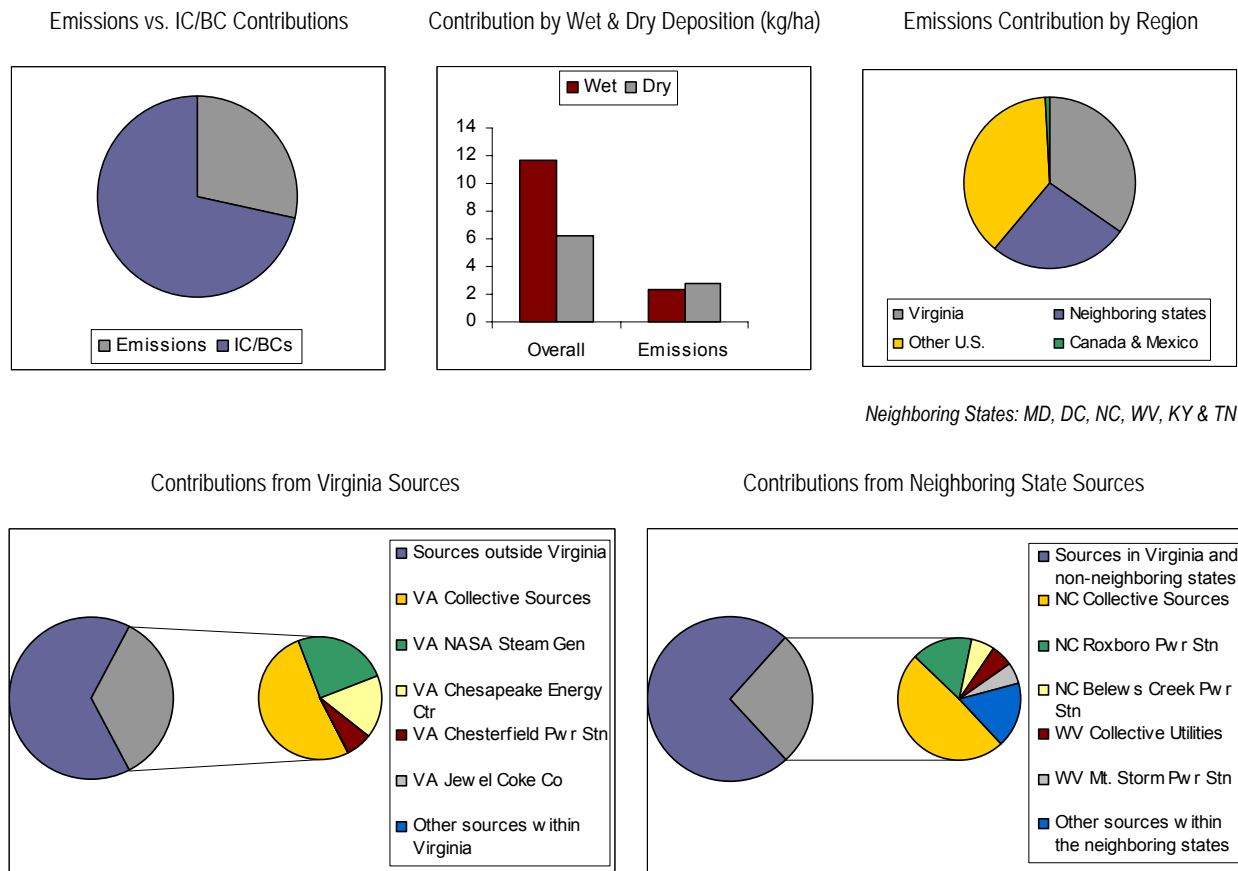
Contributions from Neighboring State Sources



*The "Collective Sources" tag for each state includes all point and area sources in the state that are not individually tagged.*

**Figure 2-4. Summary of Mercury Tagging Results for the Great Dismal Swamp, Virginia.**

Simulated Annual Hg Deposition for 2001 for Great Dismal Swamp ( $I=380$ ,  $J=161$ ): 19.7 kg/ha



The "Collective Sources" tag for each state includes all point and area sources in the state that are not individually tagged.

It is expected that our prior modeling work will greatly benefit the proposed study, both in the development of the conceptual model as well as the modeling tasks discussed later in this section. (RFP, Section III.B, Task 1)

The conceptual model will be documented in a project report for review and approval by VDEQ prior to conducting the modeling. The conceptual model will be used to guide 1) the selection of an appropriate modeling system for this study, 2) the selection of an appropriate simulation period and model input databases, and 3) the evaluation and interpretation of the modeling results. (RFP, Section III.B, Task 1)

## Task 2: Modeling Protocol

In this task, we will prepare a modeling protocol that will provide a basis for all participants to review and comment on all aspects of the modeling analysis including the modeling tools and databases, modeling domain and simulation period, modeling procedures, quality assurance procedures, schedule, and communication structures. The protocol will be used to guide the progress of the modeling analysis and any decisions that need to be made as the work is

progressing. Although there are no current guidelines for mercury modeling, we will design the modeling protocol and the modeling practices to be consistent, wherever applicable, with current EPA guidelines for ozone and particulate modeling (EPA, 2006). (RFP, Section III.B, Task 2)

An initial version of the protocol document will be developed for review and approval by VDEQ prior to conducting the modeling. It will be revised to document decisions made during the project, and finalized for inclusion in the final report. (RFP, Section III.B, Task 2)

Because of the limited time available for conducting this modeling analysis, we will work with VDEQ to outline the modeling approaches and address some of the key decisions before preparing the initial protocol document. The key decisions to be addressed early on include 1) specification of the modeling tools and databases, modeling domain, and simulation period (see Task 3 description for more discussion of these topics), 2) model performance evaluation procedures and criteria (see Task 4 description for more discussion), and 3) identification of mercury air emissions sources for tagging and Gaussian modeling (see Task 5 description for more discussion). (RFP, Section III.B, Task 2)

### ***Task 3: Model Sensitivity Analysis***

Mercury is a complex pollutant to simulate, in part because transport of mercury in the atmosphere involves many different scales. At the global scale, mercury is known to reside in the atmosphere for long periods of time and is transported around the globe in its elemental form. At the regional and local scales, divalent forms of mercury emitted from sources can have impacts downwind, in some cases immediately downwind, of those sources. Thus modeling of mercury deposition must account for the global, regional, and local components. (RFP, Section III.B, Task 3, paragraph 1)

The chemistry of mercury formation also contributes to the complexity required of mercury deposition modeling. Mercury exists in the atmosphere in an elemental form and in a number of different compounds. These various forms of mercury react with other species in the atmosphere resulting in a cycling of the airborne mercury among the different forms. (RFP, Section III.B, Task 3, paragraph 1)

Our proposed approach for mercury deposition modeling for Virginia accounts for the different scales and chemical interactions through the combined use of a state-of-the-science regional modeling system with source-contribution-assessment capabilities, specification of boundary conditions for the regional model based on global modeling, and a Gaussian model for the detailed assessment of local contributions. (RFP, Section III.B, Task 3, paragraph 1)

The schedule for the project requires the entire modeling analysis to be completed within less than approximately 11 months (assuming a start date for the project of December 1, 2006 or later). Thus, our proposed approach also includes the use of existing modeling databases and tools. (RFP, Section III.B, Task 3, paragraph 1)

This task will focus on configuring the modeling system and ensuring the suitability of the databases for the application for Virginia. In the remainder of this task description, we address modeling system and database selection and the use of model sensitivity analysis to establish the model configuration and application procedures. (RFP, Section III.B, Task 3, paragraph 1)

### **Modeling System and Database Selection**

Different types of models are designed for different scales and purposes. Gaussian models are able to resolve impacts near a source, but are not the best choice for longer range transport and

for cases involving complex chemical reactions. Grid models such as CMAQ and REMSAD are well suited to treating the influences of many emissions sources and incorporate complex chemical mechanisms. However, effects smaller than the size of a grid cell may not be resolved by these models. (RFP, Section III.B, Task 3, paragraph 1)

To account for the different scales as well as the important chemical interactions, we propose to use a two-tiered hybrid approach to the modeling. (RFP, Section III.B, Task 3, paragraph 1)

At the regional scale, we propose to use the Community Multi-scale Air Quality (CMAQ) modeling system. The CMAQ model is a state-of-the-science, regional air quality modeling system that is designed to simulate the physical and chemical processes that govern the formation, transport, and deposition of gaseous and particulate species in the atmosphere. The CMAQ modeling system supports the detailed simulation of mercury (Hg), including the emission, chemical transformation, transport, and wet and dry deposition of elemental, divalent, and particulate forms of mercury. (RFP, Section III.B, Task 3, paragraph 1)

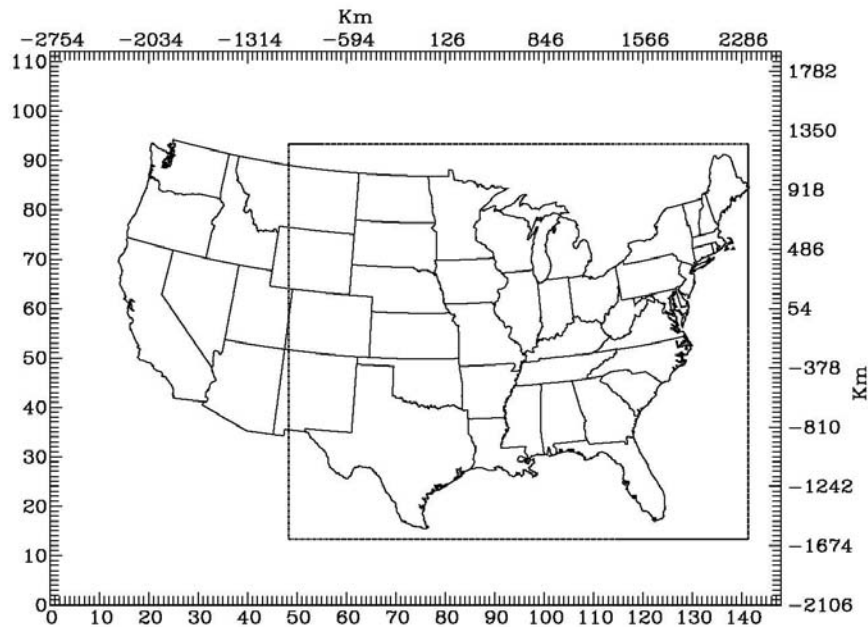
We have enhanced the CMAQ modeling system recently to include the Particle and Precursor Tagging Methodology (PPTM) for mercury (Douglas et al., 2006). This methodology is designed to provide detailed, quantitative information about the contribution of selected sources, source categories, and/or source regions to simulated mercury concentrations and (wet and dry) deposition. Mercury emissions from selected sources, source categories, or source regions are (numerically) tagged and then tracked throughout a simulation, and the contribution from each tag to the resulting simulated concentration or deposition for any given location can be quantified. By tracking the emissions from selected sources or source locations, the methodology also provides information on the fate of the emissions from these sources. (RFP, Section III.B, Task 3, paragraph 1)

To support the application of CMAQ, we currently have multiple sets of global model simulation results that can be used to provide boundary concentrations for a national- (or continental-) scale simulation of mercury. These are discussed in more detail in the next subsection. (RFP, Section III.B, Task 3, paragraph 1)

At the local scale, we propose to apply the most recent version of the EPA Gaussian model AERMOD. The AERMOD modeling would be performed for selected point sources in the Virginia emissions inventory (these would be selected based on the results of the emissions data analysis and may include up to 100 sources). We propose to use AERMOD to screen the mercury emissions sources and to determine which have the potential to impact areas outside the vicinity of the source. This screening step would provide the maximum expected impact from each source based on the directly emitted divalent forms of mercury. We will also use AERMOD (in Task 5) to simulate the effects of local emission changes for selected areas and sources. (RFP, Section III.B, Task 3, paragraph 1)

This combination of modeling tools will allow us to address the variety of factors influencing mercury deposition in Virginia. (RFP, Section III.B, Task 3, paragraph 1)

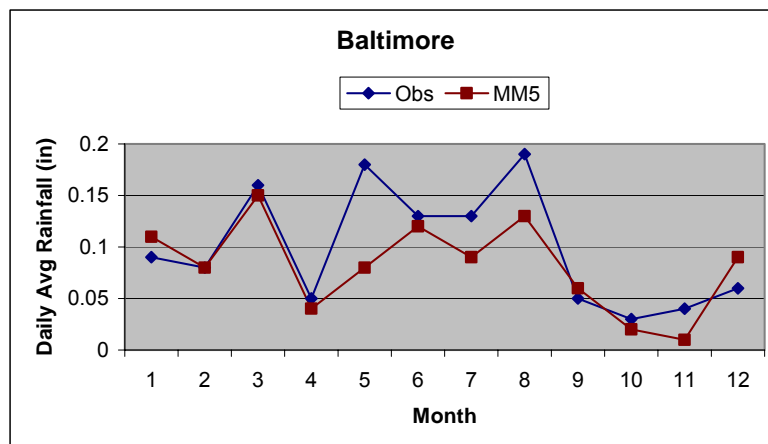
In order to apply the modeling tools, we will also need to obtain or prepare input databases to represent the emissions, meteorology and geographic characteristics of the selected modeling domain and simulation period. We propose to apply the CMAQ model for the modeling domain illustrated in Figure 2-5. This domain includes the contiguous 48 states and supports 12-km horizontal grid resolution over Virginia. (RFP, Section III.B, Task 3, paragraph 1)

**Figure 2-5. CMAQ 36- and 12-km Nested-Grid Modeling Domain.**

We also propose to use the meteorological inputs used by EPA for the CAMR modeling, and recently updated to 12-km resolution. The meteorological inputs were generated using the Fifth Generation Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Model (MM5). These meteorological inputs are for the year 2001, so the proposed annual simulation period is 2001. We reviewed these meteorological fields as part of our on-going work for the EPA OW and found that they provide a reasonable representation of the wind, temperature, and precipitation patterns for most areas in the U.S., including the Virginia area. (RFP, Section III.B, Task 3, paragraph 1)

For example, Figure 2-6 shows the variation in monthly mean rainfall amounts, observed and simulated by MM5 for the Baltimore/Washington area for 2001. The month-to-month variations and rainfall amounts are generally well represented. (RFP, Section III.B, Task 3, paragraph 1)

**Figure 2-6. Monthly Average Rainfall amount (in)  
Based on Observed and Simulated Daily Precipitation Values (2001).**



While the availability of meteorological inputs for CMAQ is an important consideration in selecting the simulation period, the lack of unusual meteorological conditions (such as the low rainfall conditions that characterized 2002 in Virginia and surrounding states) also makes 2001 a good year for modeling. Corresponding meteorological inputs for AERMOD for 2001 will be developed using observed data. (RFP, Section III.B, Task 3, paragraph 1)

For the emissions inputs, we propose to use the 2001 mercury emissions inventory that we are currently using for our mercury modeling analysis for the EPA OW (Myers et al., 2006). This inventory is based on the latest mercury emissions available from EPA, which is for 2001. We will update this inventory with any new information obtained as part of the work completed as part of the mercury emissions inventory review, discussed under Section A of the RFP. Although the Virginia updates will be for 2002, we feel that combining the 2001 national-scale inventory with 2002 Virginia updates will provide the best mercury emission inventory for the modeling, given the desire to leverage off of existing modeling databases and the constraints on the schedule. In addition to updating Virginia sources, as part of our ongoing work for the EPA OW, we prepared summaries of the emissions for each state, provided them to state and regional offices for review, and incorporated all of the updates and corrections that we received into the inventory. We will use this improved inventory for the Virginia modeling analysis. We will prepare the model-ready emissions for CMAQ using the SMOKE emissions processing program and will apply our standard quality assurance procedures to the emissions processing. Note that these will be described in the Quality Assurance Project Plan (QAPP) prepared under Task 6 (Part A). (RFP, Section III.B, Task 3, paragraph 1)

## Sensitivity Simulations

To a large extent, model configuration for CMAQ will have been determined by the selection of the meteorological databases. Consequently, sensitivity simulations geared at model configuration will focus mainly on the application of AERMOD. We will design a series of tests to determine which of the parameter settings are best suited for mercury deposition and we will explore how to maximize consistency between the AERMOD and CMAQ models. Final recommendations on the configuration of both modeling systems will be provided to VDEQ for review and approval. (RFP, Section III.B, Task 3, paragraph 1)

Following the establishment of the modeling platform, we will identify potential weaknesses in the model input fields and design and conduct sensitivity simulations to examine the effects of these weaknesses or uncertainties. For example, we may examine the sensitivity of the CMAQ simulation results to the three different estimates of boundary concentrations that are currently available. We may also examine the potential for changes in speciation in the boundary conditions to affect the simulation results. (RFP, Section III.B, Task 3, paragraph 2)

The understanding of the atmospheric chemistry of mercury is still evolving. Therefore, if the literature search from Task A-3 reveals new developments in the formulation of the mercury chemistry, ICF will consider sensitivity simulations to investigate the potential effects of new reactions, speciation, deposition rates, or other factors affecting the estimation of mercury deposition. (RFP, Section III.B, Task 3, paragraph 2)

Based on the results of the above studies, ICF will recommend a final model configuration. Any suggestions for changes to the inputs will also be provided. (RFP, Section III.B, Task 3, paragraph 3)

The result of this task will be a draft technical summary of the modeling platform selection and model sensitivity analysis. A final version of this document will incorporate/address comments

from VDEQ and will be incorporated into the modeling protocol. (RFP, Section III.B, Task 3, paragraph 4)

### ***Task 4: Model Performance Evaluation***

In this task, we will use available data and some innovative data analysis techniques to evaluate model performance for mercury deposition. We first discuss the available data and then present our approach to model performance evaluation. (RFP, Section III.B, Task 4, paragraph 1)

#### **Data Availability**

Mercury wet deposition data for Virginia are available for two Mercury Deposition Network (MDN) monitoring sites, Shenandoah National Park and Culpeper, beginning in October and November 2002, respectively. Additional data are also available for the Harcum site (in coastal Virginia) beginning in December 2004. (RFP, Section III.B, Task 4, paragraph 1)

Mercury deposition data are also available for several surrounding states, within and adjacent to the Mid-Atlantic region. The period of record for these sites varies, and there are several sites in Pennsylvania, North Carolina, South Carolina that have data for 2001. Sites in Arendtsville, Pennsylvania, Pettigrew State Park, North Carolina, and Waccamaw State Park, North Carolina are likely most representative, based on proximity and/or similar geographical features, to the areas of interest in Virginia. In particular, Pettigrew State Park, near the Albermarle Sound, may be representative of coastal Virginia. (RFP, Section III.B, Task 4, paragraph 1)

These data will have been obtained and processed in Task 1, for the period 2000-2005, in accordance with their availability. In addition, we have already obtained and worked with data for 2001 for all sites in the U.S. We will use all available observations for the model domain and region for 2001 for the direct calculation of model performance statistics. We will also use the data for 2003-2005 for sites in Virginia and throughout region to estimate deposition for 2001 at the Virginia monitoring sites. The estimated deposition values will then be used to further evaluate model performance for sites in Virginia. (RFP, Section III.B, Task 4, paragraph 1)

#### **Estimating Deposition for 2001 for the Virginia Monitoring Sites**

We will use the results from the CART analysis conducted in Task 1 to estimate deposition for 2001 for the Virginia monitoring sites. Specifically, we will classify each seven day period in 2001 according to the observed meteorological conditions and determine the corresponding CART-based classification group. We will assign the average mercury deposition for the grouping (the average over all other periods in the classification group) to the 2001 weekly period. We will do this for each period for the entire year of 2001 and then use the weekly mercury deposition values to estimate seasonal and annual deposition amounts. The key assumption here is that observed mercury deposition for the later years can be used to estimate deposition for 2001 under similar meteorological conditions. Applying this assumption on a weekly basis allows us to account for the variable effects of meteorology throughout the year. We have used a similar approach for the EPA OW, in order to estimate annual mercury deposition for a ten-year period (Douglas et al., 2003). EPA then used these values for water quality modeling and estimating fish tissue concentrations (RFP, Section III.B, Task 4, paragraph 1)

In order to confirm the reasonableness of these results, we will also apply this same method for two additional sites with longer term records. We propose the Arendtsville and Pettigrew State Park sites for this assessment. Ratios in the annual average emissions (for example,

2003/2001) for these and other sites will also be examined and compared with those for the Virginia sites using the estimated data to ensure that the CART-derived estimated values are reasonable. (RFP, Section III.B, Task 4, paragraph 1)

## Assessment of Model Performance

In this section, we present our approach to model performance evaluation for both the CMAQ and AERMOD models. Following EPA guidance for evaluating model performance, we will examine 1) whether each model is able to replicate observed (and estimated) mercury deposition data, and 2) whether the response of the model to changes in mercury emissions is reasonable. (RFP, Section III.B, Task 4, paragraph 1)

For the CMAQ model, we will compare the simulated total wet deposition of mercury with actual and estimated data for the MDN monitoring sites. We will compare simulated and observed wet deposition for each site and the average over all sites within 1) the full domain, 2) the mid-Atlantic region, and 3) Virginia. (RFP, Section III.B, Task 4, paragraph 2)

A variety of statistical measures will be used to quantify model performance. These will include

$$\text{Mean observed deposition} = 1/N \sum O_i$$

$$\text{Mean simulated deposition} = 1/N \sum S_i$$

$$\text{Normalized bias (expressed as percent)} = 100 \cdot 1/N \sum (S_i - O_i) / O_i$$

$$\text{Normalized gross error (expressed as percent)} = 100 \cdot 1/N \sum |S_i - O_i| / O_i$$

$$\text{Fractional bias (expressed as percent)} = 200 \cdot 1/N \sum (S_i - O_i) / (S_i + O_i)$$

$$\text{Fractional error (expressed as percent)} = 200 \cdot 1/N \sum |S_i - O_i| / (S_i + O_i)$$

$$\text{Mean residual} = 1/N \sum (S_i - O_i)$$

$$\text{Mean unsigned error} = 1/N \sum |S_i - O_i|$$

$$\text{Coefficient of determination (R}^2\text{)} =$$

$$(\sum S_i O_i - \sum S_i \sum O_i / N)^2 / [(\sum O_i^2 - (\sum O_i)^2 / N) \cdot (\sum S_i^2 - (\sum S_i)^2 / N)]$$

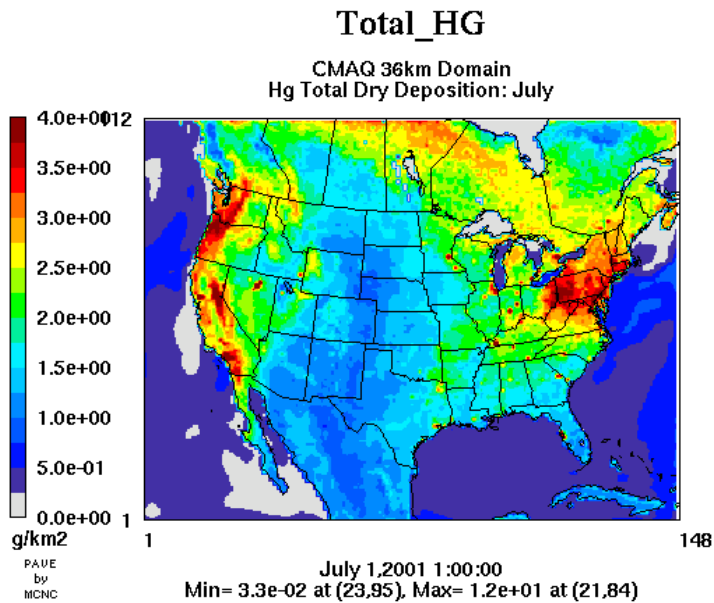
Where S is the simulated concentration, O is the observed concentration, and N is the number of simulation-observation pairs used in the calculation. Statistical measures will be calculated on a seasonal and annual basis. (RFP, Section III.B, Task 4, paragraph 2)

Plots and graphics will also be used to assess the reasonableness of the results. Spatial plots of the simulated and observed values will be used to qualitatively assess the ability of the model to emulate the spatial deposition patterns. Monthly time-series plots comparing these same values at the monitoring sites will be used to determine whether the timing and magnitude of the simulated values matches the observations. Scatter plots will also be used to graphically compare the simulated and observed deposition values. (RFP, Section III.B, Task 4, paragraph 2)

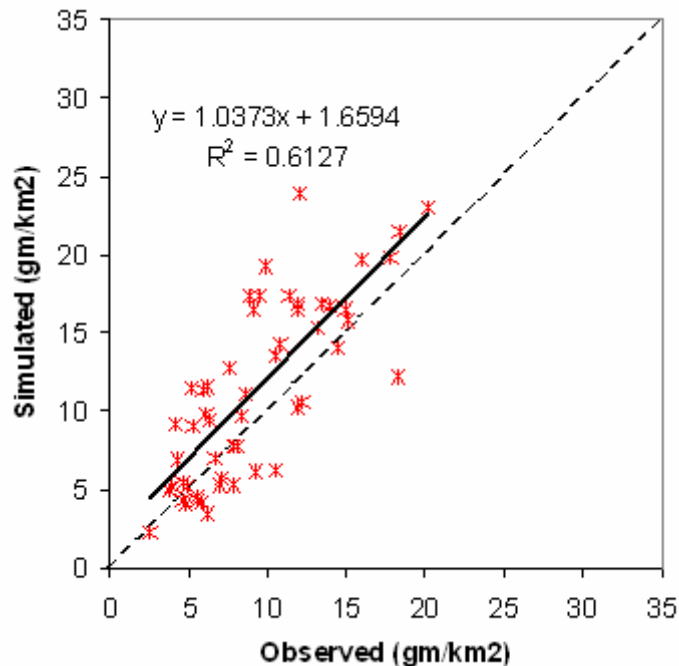
An example spatial plot showing CMAQ simulated mercury dry deposition for July 2001 is provided in Figure 2-7. An example scatter plot comparing REMSAD-simulated and observed mercury wet deposition for all monitoring sites in the U.S. for a 2001 model application is

provided in Figure 2-8. This particular example indicates that mercury deposition is slightly overestimated by the REMSAD model. (RFP, Section III.B, Task 4, paragraph 2)

**Figure 2-7. Example CMAQ PPTM Mercury Tagging Results for June 2001:  
Dry Deposition ( $\text{g km}^{-2}$ ).**



**Figure 2-8. Simulated and Observed Annual Total Wet Deposition of Mercury for 2001.**



As part of the model performance evaluation, we will examine the response of the model for the sensitivity simulations conducted in Task 3. For example, we will ensure that the model

responds in a reasonable way (based on our current knowledge of mercury chemistry and transport) to changes in the boundary conditions and changes in the speciation profiles of the emissions and /or boundary conditions. We will use PPTM as a probing tool and examine the PPTM results from Task 6 to verify that the contributions from selected emission sources are commensurate with the locations and emissions of the sources as well as the prescribed meteorological conditions. (RFP, Section III.B, Task 4, paragraph 3)

For AERMOD, we will conduct a limited performance evaluation to assess whether the model is able to simulate the deposition distributions and maximum values represented by the observed and estimated data. As for CMAQ, we will examine the response of the model for the sensitivity simulations conducted in Task 3 to ensure that the model responds in a reasonable way (based on our current knowledge of near-source mercury deposition) to changes in the meteorological and emissions inputs. (RFP, Section III.B, Task 4, paragraphs 2 and 3)

### Model Performance Goals

In keeping with current EPA guidance on model performance evaluation for other pollutants, we will use a “weight-of-evidence” approach to determine whether model performance for both CMAQ and AERMOD is good enough for use in future-year modeling and control measure assessment. For CMAQ, this will be based on the statistical performance measures, the response of the model to changes in the inputs, and the reasonableness of the PPTM contribution results. For AERMOD, this will be based on the comparison of simulated and estimated data – particularly the distribution and maximum values. We will also compare the CMAQ and AERMOD results to assure that the simulated local contributions from AERMOD bound the CMAQ results, as they are expected to be more likely to represent the maximum impact from directly emitted divalent forms of mercury from a source. (RFP, Section III.B, Task 4, paragraphs 2 and 3)

The model performance evaluation task will be documented in a draft technical report. A final version of this document will incorporate/address comments from VDEQ and will be incorporated into the full mercury deposition modeling report developed under Task 6. (RFP, Section III.B, Task 4, paragraph 4)

### *Task 5: Modeling Simulations*

In this task we will use both the CMAQ and AERMOD models to examine the contributions of a variety of sources to mercury deposition to Virginia’s “impaired” water bodies. (RFP, Section III.B, Task 5, paragraph 1)

### Baseline Modeling

As a first step in the modeling we will conduct several simulations using the baseline 2001 emissions inventory. The RFP lists several simulations to assess contributions of various source sectors to mercury deposition to water bodies in Virginia, and we will use CMAQ to simulate each of these scenarios. (RFP, Section III.B, Task 5, paragraph 1)

The first scenario will examine and quantify the contributions from mercury air emissions sources in 1) Virginia, 2) the mid-Atlantic region (or selected neighboring states), 3) all other U.S. states, and 4) Canada and Mexico, as well as the contribution from 5) global emissions sources. As noted earlier, ICF plans to use the CMAQ Particle and Precursor Tagging Methodology (PPTM), which efficiently estimates the contributions of several sources, source regions, or source categories in a single simulation. The contributions from a variety of different sources can be

estimated in a fraction of the time it would take to run a separate simulation for each. We will assign tags to each of the five regions/categories listed above. An initial/boundary condition tag will represent the global impact on deposition. This set of tags provides estimates of Virginia, regional, national, and global impacts on deposition for any location (grid cell or group of grid cells) within the state or the modeling domain. (RFP, Section III.B, Task 5, paragraph 1)

The second scenario will quantify the contributions from Electric Generating Unit (EGU) and non-EGU facilities in Virginia. We will tag 1) all of Virginia's EGU sources and separately 2) all of the non-EGU sources in the state. The results will allow VDEQ to quantify and compare the contributions from these two source sectors to mercury deposition for any location (grid cell or group of grid cells) within the state or the modeling domain. (RFP, Section III.B, Task 5, paragraph 1)

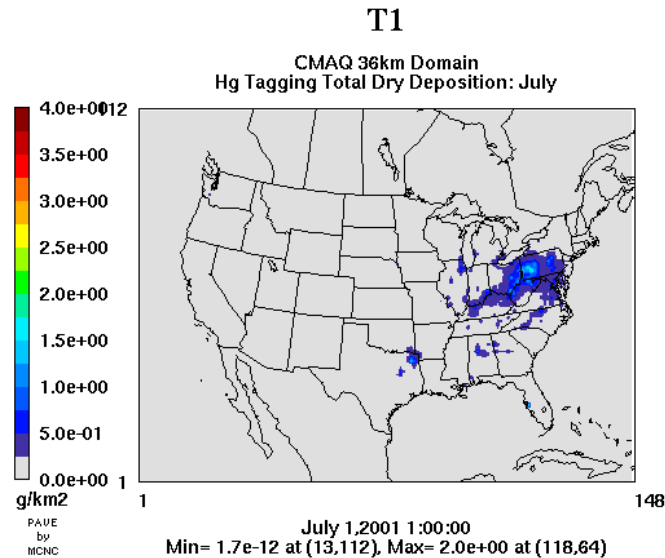
The third CMAQ scenario will examine the contributions from other sources that, based on the original AERMOD screening test in Task 3, were identified to have potential impacts on mercury deposition outside of their immediate vicinity (potential non-local or regional impacts). This scenario may involve more than one CMAQ simulation, since currently each CMAQ PPTM simulation can include up to seven tags. These results will allow VDEQ to quantify the contributions from facilities with a potential regional influence, extending across a large portion of the state. (RFP, Section III.B, Task 5, paragraph 1)

Finally, to conclude the baseline modeling, we will apply AERMOD to those sources that were identified in Task 3 to have significant local impacts on one or more of Virginia's "impaired" water bodies. These results will allow VDEQ to quantify the contributions from individual sources with a potentially significant local impact. (RFP, Section III.B, Task 5, paragraph 1)

Any changes to the inputs or emissions incorporated as a result of the diagnostic and sensitivity testing and performance evaluation (Tasks 3 and 4) will be reflected in the baseline application of CMAQ and AERMOD. We will provide the baseline emissions to VDEQ for review and approval prior to conducting the baseline modeling. (RFP, Section III.B, Task 5, paragraphs 1 and 3)

The CMAQ PPTM results will be displayed in a variety of graphical and tabular formats. Spatial plots depicting the contributions from each of the tagged sources or source categories will be prepared. An example of this type of plot is shown in Figure 2-9. Of course, plots for the proposed study would focus in on Virginia. (RFP, Section III.B, Task 5, paragraph 1)

**Figure 2-9. Example CMAQ PPTM Mercury Tagging Results for June 2001: Contribution to Mercury Deposition from EGU Sources (g km<sup>-2</sup>).**



We will also work with VDEQ to assemble a list of water bodies and hydrologic zones and will conduct a detailed analysis of the results for these areas. Specifically, we will prepare tabular summaries of the results, including total deposition, total wet and dry deposition, deposition by species, and contribution by source and/or source category for each of the areas of interest. In addition to the tabular summaries, we will also display the results in a manner similar to that presented in Figures 2-1 and 2-2. (RFP, Section III.B, Task 5, paragraph 1)

The AERMOD results of the local contributions will be summarized using tables as well as pie and bar charts similar to those presented in Figures 2-1 and 2-2. (RFP, Section III.B, Task 5, paragraph 1)

## Future-Year Emission Inventory Preparation

To support the future year modeling, we will prepare model-ready future year emission inventories. These will be prepared for 2010, 2015, and 2018 using the projected emissions from the emissions data analysis component of the project. This will include the use of the Integrated Planning Model (IPM) to estimate future-year EGU emissions. We will provide the project future-year emissions, including growth and control assumptions, to VDEQ for review and approval prior to conducting the future year modeling. (RFP, Section III.B, Task 5, paragraphs 2 and 3)

Emissions for AERMOD will be directly obtained from these estimates. For CMAQ, the model-ready emissions will be processed using the SMOKE emissions processing program. We will apply our standard quality assurance procedures, as described in the QAPP, to the emissions processing. (RFP, Section III.B, Task 5, paragraphs 2 and 3)

The future-year emissions will reflect the CAMR for all states. For Virginia, the future year emissions will include the requirements of the state-specific rules that are being developed in conjunction with the Virginia General Assembly (HB1055). This is discussed in more detail as part of Task 2 of the emissions data analysis. (RFP, Section III.B, Task 5, paragraphs 2 and 3)

We will work with DEQ to translate these rules and provisions into emissions estimates and incorporate them into the future-year emission inventories, staging them as appropriate, for each future year. (RFP, Section III.B, Task 5, paragraphs 2 and 3)

### **Future-Year Modeling**

The future-year modeling exercises will include the same CMAQ PPTM and AERMOD runs as the baseline simulations. For each future year, we will examine the simulated change in mercury deposition, overall and from each tagged or modeled source or source category. The use of the PPTM methodology will enable us to attribute the future-year reductions in mercury deposition for each area of interest to the specific tagged sources or source categories. Graphical and tabular summaries of the results will be prepared. (RFP, Section III.B, Task 5, paragraph 2)

Our analysis of the results will focus on the effectiveness of the various measures and emissions changes in reducing future-year mercury deposition. Given the uncertainties associated with mercury deposition modeling, we will emphasize the relative changes in deposition associated with the emissions changes for each source and source category in our analysis of the results. (RFP, Section III.B, Task 5, paragraph 2)

### ***Task 6: Mercury Deposition Modeling Report***

This task will cover the preparation of the documentation for the study. The report will summarize the data, methods, and results of the study. A portion of the report will be devoted to a discussion of the uncertainties and limitations associated with the methods and the modeling results, based on known data limitations, input preparation assumptions, model formulation and modeling assumptions, model performance, and differences between the CMAQ and AERMOD results. As noted earlier, this report will include revised, updated versions of draft report sections prepared as part of Tasks 3 and 4. (RFP, Section III.B, Task 6, paragraph 1)

The report will contain an executive summary, technical details of all aspects of the modeling analysis, a discussion of the uncertainties and limitation of the results, and information on how to access and utilize the modeling datasets. The report will contain a variety of graphical summaries of the inputs and results including, as required in the RFP, maps illustrating simulated mercury deposition, stationary source emissions, and fish consumption advisory information for each of the future-year analyses. (RFP, Section III.B, Task 6, paragraph 1)

We will develop and submit an outline for the report for review by VDEQ prior to preparation of the draft report. Draft and final versions of the report will be prepared. The final report will be incorporate and address comments by VDEQ and will be completed within four weeks of receipt of the comments. (RFP, Section III.B, Task 6, paragraphs 2 and 3)

### ***Task 7: Data Archival and Transfer of Inventory Files***

All of the data, data files, and software required to corroborate the results and findings of the study will be provided to VDEQ in an approved electronic format. As noted in the RFP, we may utilize ftp methods for transfer of smaller files and will use portable disk drives for the transfer of larger files and/or the complete database. (RFP, Section III.B, Task 7)

### ***Task 8: Quality Assurance Plan***

The QAPP covering both the emissions inventory review and deposition modeling work will be prepared as one document as part of Section A, Task 6. (RFP, Section III.B, Task 8)

### ***Task 9: Project Management***

As discussed in Section 3 of the proposal document, the proposed project manager for the mercury deposition analysis is Mr. Jay Haney. Mr. Haney has more than 27 years of experience in the conduct and management of meteorological, emissions, and air quality data analysis and modeling studies. He is a Vice President with ICF International with the authority to utilize all of the resources of our firm to ensure the high quality, effective, timely, and efficient completion of the proposed study. As discussed in our capabilities statement, Mr. Haney has successfully managed more than 25 studies that are similar to the size and scope of the proposed effort. He will be responsible for the:

- Day-to-day management of all technical tasks.
- Technically sound and efficient completion of each task and the entire project.
- Communication with the VDEQ, including the exchange of ideas and information and prompt responses to questions from VDEQ.
- Development and refinement of the project scope of work in cooperation with VDEQ and other project participants
- Conformity with the modeling protocol and implementation of the QAPP
- Resolution of any technical and project-management-related issues.
- Quality and timeliness of all project deliverables.

As part of this task, Mr. Haney and other scientists from ICF will participate in biweekly (or as needed) conference calls and up to four one-day project meetings covering the emissions data analysis and modeling work. (RFP, Section III.B, Task 9, paragraphs 1 and 3)

During the first month of the project, ICF will prepare a work plan that includes the objectives, scope, budget, and schedule for each task. The work plan will be revised as needed during the course of the project to reflect progress to date and to ensure a successful completion of the project. (RFP, Section III.B, Task 9, paragraph 2)

Each month progress will be evaluated against this work plan and summarized in a written status report to VDEQ. The status reports will provide a detailed discussion of work accomplished during the report period, results achieved during the reporting period, problems encountered and how they were resolved, and planned activities for the next two months. The status report will also include a summary of expenditures for the period and cumulative expenditures for the project. (RFP, Section III.B, Task 9, paragraph 2)

### ***Task 10: Other Tasks Not Assigned***

ICF will be pleased to provide a scope of work and cost estimate for any additional tasks that arise during the course of the study. (RFP, Section III.B, Task 10)

### 3. Qualifications and Experience of the Project Team (RFP, Sections IV.B.3, V.B.1)

In this section, we summarize the qualifications and prior experience of the proposed project team, with emphasis on recent projects related to mercury emission inventory development, mercury deposition modeling, and data analysis. For portions A and B of the Virginia mercury study, ICF International's air quality modeling group will lead the effort and will be assisted by members of ICF's energy and risk assessment groups. ICF will also be joined by LPES, Inc., a Virginia registered small business enterprise and Thruput, a Virginia registered woman-owned business. An overview of the project team is provided below. This is followed by a summary of the education and experience of the proposed project participants and a discussion of the specific qualifications and roles/responsibilities of the core project team members. (RFP, Section IV.B.3.)

#### Overview of the Project Team

**ICF International** ([www.icfi.com](http://www.icfi.com)) partners with government and commercial clients to deliver consulting services and technology solutions in environment, energy, transportation, economics, social programs, and homeland security. For more than 35 years, the ICF air quality modeling and analysis group (formerly SAI) has been a leader in the development and use of advanced analysis and modeling tools to support air quality assessments of primary and secondary pollutants. In the area of air quality modeling, ICF scientists developed the Urban Airshed Model (UAM/UAM-V) modeling systems and the particulate/aerosol model known as the REgional Modeling System for Aerosols and Deposition (REMSAD). Much of our current work involves the further development and application of the EPA Community Multiscale Air Quality (CMAQ) model. (RFP, Section IV.B.3.)

Since 1997, ICF has been working with the EPA Office of Water to develop innovative air quality modeling approaches to provide more refined estimates of atmospheric mercury (and nitrogen) deposition for studies of the nation's watersheds. This work has included incorporation of mercury chemistry into the REMSAD model and the application of the model for selected annual periods. The Office of Water has made it a priority to support the development of air quality modeling tools to provide more accurate estimates of atmospheric deposition, because these estimates are critical inputs to subsequent water quality modeling studies, uptake estimates, and health risk assessments. ICF has been a leader in the effort to couple the capabilities of air quality models to provide crucial pollutant deposition information for water quality modeling exercises conducted for health risk assessments or Total Maximum Daily Load (TMDL) analyses. ICF has recently conducted air quality deposition modeling for mercury TMDL assessments for Wisconsin, the Everglades, Maryland, and various Louisiana water basins. (RFP, Section IV.B.3.)

To facilitate the model-based analysis of source contribution, ICF scientists have developed the Ozone and Precursor Tagging Methodology (OPTM) and the Particle and Precursor Tagging Methodology (PPTM). These techniques allow the contribution from tagged sources, source categories, or source regions to be explicitly calculated for any location within the modeling domain. As part of this ongoing work, ICF scientists originally implemented PPTM for mercury into the REMSAD model and have recently added PPTM for mercury, sulfur, nitrogen, and particulate species to the CMAQ model. In a study conducted in 2004, ICF scientists applied the REMSAD model to assess atmospheric mercury deposition to the continental U.S., focusing on Devil's Lake, Wisconsin and the Everglades. In our current work for the Office of Water, ICF is applying both

REMSAD and CMAQ (with PPTM) to estimate the impact of sources of mercury to the lower 48 states, including Virginia. (RFP, Section IV.B.3.)

During the past ten years, a key part of ICF's air quality work has involved the use of statistical analysis tools (including the Classification and Regression Tree (CART) software) to conduct data analysis to guide and support modeling efforts. We have used the CART technique extensively to investigate relationships between meteorology and observed ozone, PM<sub>2.5</sub>, visibility, and mercury in more than 25 different areas, including for the Virginia area. The CART data analysis results have been used to evaluate air quality models, select representative episodes for modeling, calculate meteorologically-adjusted trends, support "weight-of-evidence" arguments for ozone SIPs, and develop ozone and PM<sub>2.5</sub> forecasting tools for more than 15 different areas, including for Virginia and the mid-Atlantic states. We have also used CART analysis to estimate annual mercury deposition for a multi-year period and provide inputs for water quality modeling and estimating fish tissue concentrations. (RFP, Section IV.B.3.)

To support our full-service air quality modeling program, ICF's capabilities also include emission inventory preparation and quality assurance; meteorological modeling (in particular, the use of MM5 to prepare inputs for photochemical modeling), and database management. ICF scientists have developed more than 200 emission inventories for air quality modeling, including national-scale mercury inventories. We have also developed comprehensive database management tools to support the integrated analysis of data and modeling results. For example, the Access Database for Visualizing and Investigating Strategies for Ozone Reduction (ADVISOR) tool is an interactive database tool that supports quick and easy access to the data and modeling results by study participants, using graphical and tabular summaries and a variety of metrics. (RFP, Section IV.B.3.)

In addition to our mercury modeling work for EPA's OW and other air quality data analysis and modeling experience, ICF has also conducted other mercury-related assessments for various offices of EPA including the Office of Policy, Economics, and Innovation related to the Clean Air Mercury Rule (CAMR); the Office of Air Quality Planning and Standards for the preparation of the 1997 and 2000 Mercury Reports to Congress, the development and application of the TRIM.FaTE modeling system for mercury, and the Great Waters Report to Congress; and the Office of Research and Development, National Center for Environmental Research, for preparation of a synthesis report to summarize progress in mercury research conducted under the FY99 Science to Achieve Results (STAR) mercury grant program. (RFP, Section IV.B.3.)

Over the past 20 years, ICF's energy markets group has provided a broad range of power sector modeling and analytical support to air regulatory agencies, regional planning organizations, state and local clients, non-governmental organizations and private industry. The group currently supports the U.S. EPA Clean Air Markets Division in their air regulatory analysis. Our support involves application of ICF's Integrated Planning Model (IPM®) to analyze the economics of alternative multi-pollutant emissions regulatory and legislative proposals. We have supported EPA's Clean Air Markets Division in all of their major air regulatory rulemakings and related initiatives in recent years including the Clean Air Power Initiative; the NOx SIP Call; Clear Skies; the recent the Clean Air Rules of 2004, including the interstate transport (CAIR), visibility (CAVR) and mercury rules (CAMR); and analysis of proposed climate legislation. (RFP, Section IV.B.3.)

We also provide support to several other organizations within EPA using IPM to address questions on energy and environmental issues. We have provided support to the Office of Water examining proposed water regulations, the National Center for Environmental Economics

examining mercury issues, and the Climate Protection Partnership Division of EPA, examining energy efficiency and fuel markets. We have recently supported the Clean Air Task Force; the VISTAS, MidWest, CENRAP, and MANE-VU Regional Planning Organizations (RPOs); the Illinois EPA, New York State Energy Research and Development Agency, and the National Commission on Energy Policy on various analytic and modeling initiatives primarily related to mercury and SO<sub>2</sub> and NO<sub>x</sub>. (RFP, Section IV.B.3.)

**LPES, Inc.** of Smithfield, VA, a Virginia certified Small Business Enterprise, provides air-quality, acoustical, and transportation planning services to both government and private clients. LPES has extensive experience performing air conformity analysis, air modeling, and air emission calculations for regulatory compliance, permitting, and NEPA support projects. LPES also specializes in noise compliance and planning. Its staff has a broad knowledge base in the prediction, impact analysis, planning, and mitigation of noise and its effects on humans, endangered species, and marine mammals. In addition to its core competencies, LPES also provides land use planning, transportation, and socioeconomic impact assessment. (RFP, Section IV.B.3. and 6.)

**Thruput**, a Virginia certified Woman Owned Business, has the capacity and qualifications to evaluate, calculate, compile and analyze air emissions from point sources. Thruput has the professional background and governmental/private experience to assist in evaluating the quality of emissions from a variety of industrial sources. (RFP, Section IV.B.3. and 6.)

## Summary of Education and Experience of Proposed Personnel

The experience of the ICF project team in each of the required areas is summarized in Table 3-1. (RFP, Section IV.B.3.b.)

**Table 3-1. Summary of Education, Years of Experience, and Number of Projects for Areas Relevant to the Virginia Mercury Study for Key ICF Project Personnel.**

	Haney	Douglas	Myers	Burch	Wei	Hudis-chewskyj	Venkatesh
Education (highest degree)	MS	MS	MA	MEM	MS	BS	PhD
Number of years of air quality analysis experience	27	20	29	11	17	27	10
Project related experience within the past 10 years for:							
Mercury emission inventory and modeling	✓	✓✓	✓✓✓	✓✓	✓✓✓	✓	✓✓✓
Mercury assessment studies	✓	✓	✓✓✓	✓✓	✓✓		✓✓✓
Regional- & urban-scale air quality modeling	✓✓✓	✓✓✓	✓✓✓		✓✓✓	✓✓✓	
CMAQ modeling	✓	✓✓	✓✓		✓✓	✓	
Gaussian modeling	✓	✓	✓		✓✓	✓	
Emission inventory review, processing, and quality assurance	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓	✓✓✓
CART Data Analysis	✓✓✓	✓✓✓	✓		✓	✓✓✓	

✓ = 2 to 4 projects      ✓✓ = 4 to 8 projects      ✓✓✓ = 8 or more projects

## Qualifications and Roles/Responsibilities of Core Project Participants

This section presents the ICF project team, including qualifications of each member in conducting similar work, and the roles and responsibilities they will have during the course of the study. The resumes of these individuals are provided in an appendix. (RFP, Section IV.B.3.)

For this effort, **Jay Haney** will serve as Project Manager while **Sharon Douglas** will serve as Technical Coordinator. Mr. Haney and Ms. Douglas have worked together and served in similar complementary roles on numerous large air quality data analysis and modeling studies during the last 15 years. Other key personnel from ICF include **Tom Myers** who will lead the mercury modeling application, evaluation, and sensitivity analysis, **Belle Hudischewskyj**, who will lead the collection and processing of any air quality and meteorological data related to the mercury trends analysis, **David Burch**, who will be involved in the mercury emissions inventory data evaluation and literature search, and **YiHua Wei**, who will participate in the emissions evaluation and lead the emissions inventory preparation work and the AERMOD application for the mercury deposition modeling task. **Dr. Boddu Venkatesh** will participate in identifying/reviewing emissions inventory information provided by ICF's IPM energy demand model. Additional ICF personnel will participate in the study and provide support to the key personnel, as appropriate. (RFP, Section IV.B.3.)

**Mr. Tim Lavallee** from LPES, Inc. and **Ms. Diane Shotynski** of Thruput will assist ICF with the mercury emissions data analysis task. (RFP, Section IV.B.3.)

### Jay Haney

**Summary of Qualifications and Experience:** Jay Haney is a Vice President at ICF and is the head of the air quality modeling group. Mr. Haney has 27 years of experience in the area of air quality data analysis and modeling. He specializes in emission inventory assessment and air quality model application studies. Mr. Haney has been involved in more than 50 ozone, PM<sub>2.5</sub>, and mercury modeling studies, and has served as the project manager for numerous SIP-related (for example, Atlanta, Baton Rouge, Birmingham, Cincinnati, Louisville, Phoenix, Sacramento) and Early Action Compact (EAC) (for example, Chattanooga, Knoxville, Little Rock, Nashville, Shreveport, Tri-Cities) ozone modeling studies. He recently served as project manager for all three phases of the Gulf Coast Ozone Study (GCOS), the Mississippi Coastal Improvement Assistance Program (CIAP) modeling study, the West Florida Ozone Study (WFOS), and the Arkansas-Tennessee-Mississippi Ozone Study (ATMOS), which involved data analysis, episode selection, emission inventory development, and model application to address EPA's new 8-hour ozone standard. He has led the development of numerous emission inventories supporting air quality modeling studies for ozone, CO, and PM and is knowledgeable regarding the NEI, emissions estimation/modeling techniques, and projection methodologies. Currently, Mr. Haney is the project manager for a CMAQ application study for enhanced PM<sub>2.5</sub> analysis of the Southeast. He is also involved in the REMSAD 48-state mercury modeling analysis for the EPA Office of Water. (RFP, Section IV.B.3.)

Since 2000, Mr. Haney has authored or co-authored more than 35 technical reports and technical support documents, all of which have been peer reviewed by our clients and their technical advisors. He has consistently demonstrated the ability to deliver practical, well-documented, high-quality technical work products within established contract schedules and

budget constraints. Mr. Haney holds B.S. and M.S. degrees in Meteorology from Saint Louis University and is an AMS Certified Consulting Meteorologist (CCM). (RFP, Section IV.B.3.)

**Role and Responsibilities:** Mr. Haney will serve as Project Manager for the study. He will be the principal point of contact for the VDEQ, and will work closely with Ms. Douglas, in communicating status, progress, and the resolution of any problems encountered during the study. Mr. Haney is a Vice President and corporate officer with ICF and has the authority to ensure that adequate corporate and administrative resources are available to accomplish the technical objectives and meet the proposed schedule and budget. (RFP, Section IV.B.3.)

## Sharon Douglas

**Summary of Qualifications and Experience:** Ms. Sharon Douglas is a Project Manager at ICF and has nearly 20 years of experience in the development, refinement, and application of meteorological and air quality analysis and modeling techniques. At ICF, Ms. Douglas has been principally involved in the development and application of meteorological and air quality modeling tools. She has served as principal investigator for more than 25 projects involving the combined application of meteorological models and urban- and regional-scale air quality models for regulatory purposes. One of her specializations is meteorological modeling, and she has 25 years of experience in working with MM5 and nearly 20 years of experience in using dynamic meteorological models to prepare inputs for air quality modeling. Ms. Douglas has also successfully managed more than 35 projects involving the analysis of air quality/ meteorological data, and the development, and application of data analysis and modeling tools. (RFP, Section IV.B.3.)

Within the air quality modeling group, Ms. Douglas has led the development and application of innovative data analysis techniques, primarily designed to examine the relationships between meteorology and air quality and to use this information to enhance air quality modeling, forecasting, and planning. Ms. Douglas recently served as the project manager for the VISTAS meteorological characterization study. The results from this study are being used by VISTAS to guide the use of modeling results for PM<sub>2.5</sub> and regional haze planning. She is also currently the project manager for a data analysis project involving the use of IMPROVE, STN, and SEARCH data to explore the relationships between aerosol formation, composition, and transport and meteorology. Both of these studies have included the detailed analysis of meteorological and PM<sub>2.5</sub> data using the CART analysis software. This experience will be used in developing the approach and conducting the mercury trends analysis work for this study. Ms. Douglas recently managed a work assignment for EPA OAQPS for incorporating mercury PPTM tagging into the CMAQ model. Ms. Douglas is currently involved in the REMSAD 48-state mercury modeling analysis for the EPA Office of Water where she is leading the display and analysis of modeling results. (RFP, Section IV.B.3.)

Since 2000, Ms. Douglas has authored or co-authored more than 50 technical reports and technical support document, all of which have been peer reviewed by our clients and their technical advisors. She has participated in dozens of project meetings and conferences and has consistently demonstrated the ability to present technical information in an organized, thorough, and understandable manner. Ms. Douglas has an outstanding reputation within the air quality modeling community for providing sound technical advice and delivering creative, high-quality technical work products. She has a M.S. degree in Meteorology from the Pennsylvania State University, and a B.A. degree in Atmospheric Science from the Johns Hopkins University. (RFP, Section IV.B.3.)

**Role and Responsibilities:** Ms. Douglas will coordinate the technical work to be completed for the proposed emission inventory evaluation, data analysis, and mercury deposition modeling study. She will work closely with Mr. Haney to: 1) develop the modeling recommendations and protocol, 2) develop the approach for the mercury data analysis, 3) conduct the modeling and technical analyses, 4) communicate ongoing technical information to the VDEQ project participants by participating in conference calls and status meetings, and 5) prepare the draft and final reports. She will have day-to-day responsibilities to manage the technical work conducted by all project participants and will work closely with Mr. Haney to ensure that the work is completed on schedule and within budget. (RFP, Section IV.B.3.)

## Tom Myers

**Summary of Qualifications and Experience:** Tom Myers is a Project Manager at ICF and has more than 29 years of experience in air quality model application and development. His principal areas of experience are in the application and development of photochemical air quality model systems for ozone and particulate matter. Mr. Myers has managed a number of modeling applications using UAM-IV, UAM-V, REMSAD, and CMAQ among other models. For the U.S. EPA Office of Water, Mr. Myers is currently managing a project to estimate the contribution of the mercury emissions from various states to water bodies. For the U.S. EPA Office of Air Quality Planning and Standards, Mr. Myers recently managed a project to update the documentation for REMSAD and to update and test improvements to the REMSAD system. Improvements implemented included: a secondary organic aerosol (SOA) module to simulate the formation of these organic products; an expanded treatment of fine and coarse fractions of various particulate species, and the implementation of the Particle and Precursor Tagging Methodology (PPTM) capabilities for nitrogen, sulfur, and mercury, which tracks the fate of these species to assess downwind contribution. Mr. Myers also recently incorporated PPTM into the CMAQ model, which is being evaluated as part of the EPA OW mercury tagging assessment of the lower 48 states. This work was recently presented at the CMAS conference in Durham, North Carolina (October 2006). (RFP, Section IV.B.3.)

Mr. Myers is quite knowledgeable in the science of mercury chemistry, transport, and deposition, as substantiated by his work in mercury model development. Currently, he is the principal investigator for the EPA OW mercury tagging and deposition modeling study. Mr. Myers has a M.A. degree in Physics from the University of California, Davis. (RFP, Section IV.B.3.)

**Role and Responsibilities:** Mr. Myers will lead the set up and application of CMAQ with PPTM, as well as the processing and analysis of the CMAQ and mercury tagging results. He will assist in evaluating both air quality models, and will apply his understanding of the physical and chemical processes affecting mercury to the analysis of the results. (RFP, Section IV.B.3.)

## David Burch

**Summary of Qualifications and Experience:** David Burch, a Project Manager in ICF's Environment, Transportation, and Regulation practice, has eleven years of professional experience in risk assessment and environmental chemistry. Much of his work has involved managing tasks and providing expertise related to air and multimedia fate and transport modeling, exposure assessment, and risk characterization of air pollutants for EPA and other public and private clients. He is familiar with the behavior of mercury in the environment, current approaches for modeling fate and transport of mercury, the toxicology of mercury, and issues regarding risk assessment of mercury for humans and ecological endpoints. Mr. Burch was a key analyst in the mercury test case application of EPA's TRIM.FaTE fate and transport model,

for which he collected input data and conducted parameter sensitivity analyses, performed additional mercury modeling using IEM-2M (the EPA multimedia exposure model developed to calculate human exposures to mercury for the 1997 Mercury Study Report to Congress), and performed a quantitative comparison of TRIM.FaTE results to monitoring data available for the chlor-alkali facility that was the subject of the test case. Mr. Burch played a key supervisory and technical role in ICF's support to EPA in the development of the 2005 Clean Air Mercury Rule (CAMR) by coordinating logistical and documentation support for a series of internal EPA workshops focused on the risk assessment design for the rule, conducting literature searches and data collection efforts regarding the toxicology of mercury and human health routes of exposure, and authoring summary text regarding the toxic effects of mercury that was included in the Regulatory Impact Analysis for the final rule. He also played a key role in ICF's comparative assessment of potential impacts related to mercury deposition from coal-fired power plants for a private client and provided technical and documentation support in the compilation of EPA's Mercury Study Report to Congress. Mr. Burch currently serves as the Deputy Program Manager for ICF's mission support contract with EPA's Office of Air Quality Planning and Standards to provide technical risk assessment support for EPA regulatory initiatives regarding hazardous and criteria air pollutants. (RFP, Section IV.B.3.)

**Roles and Responsibilities:** Mr. Burch will be involved in the mercury emissions inventory analysis tasks. He will take the lead in conducting the literature search as part of Section A, Task 4. (RFP, Section IV.B.3.)

## YiHua Wei

**Summary of Qualifications and Experience:** Ms. YiHua Wei, Senior Associate at ICF, has more than 17 years experience in air quality modeling, emission inventory development and preparation, and air toxics risk assessment. Ms. Wei specializes in the processing and quality assurance of emissions data and the preparation of modeling emission inventories. She is experienced in the application of SMOKE and EPS2.5. Within the past several years, she has developed base-case and future-year emission inventories for numerous regional and national-scale modeling projects including GCOS/CIAP, WFOS, ATMOS, Baton Rouge SIP modeling, South Carolina 8-hour ozone modeling, and several EPA-sponsored national PM and mercury tagging analyses. She has also prepared national criteria pollutants and mercury inventories for REMSAD modeling for EPA's Clean Air Markets Division (CAMD), the Lake Michigan Air Directors Consortium (LADCO), and EPA's Office of Water, using EPS2.5. Ms. Wei is responsible for the development of ICF's modeling emission inventory quality assurance practices, which set our group apart from others in the air quality modeling community, as substantiated by fewer versions of emission inventories for regional-scale modeling. Ms. Wei has developed processed numerous national-scale mercury emission inventories for a number of REMSAD and CMAQ model applications for the EPA Office of Water. (RFP, Section IV.B.3.)

Ms. Wei has more than ten years of experience in Gaussian air quality modeling. She has applied the Gaussian dispersion model (ISC3, now AERMOD) for numerous regulatory and toxic risk assessment analysis projects. In the past year, she has worked for EPA on a residual risk assessment for coke-oven facilities using the Gaussian ISCST model. She has also applied CAL3QHCr and CALPUFF to model the pollutant concentrations near roadway intersections. Ms. Wei also participated in the application of CART for the analysis of meteorology, PM<sub>2.5</sub>, and visibility within the VISTAS region. (RFP, Section IV.B.3.)

Ms. Wei received an MS in Atmospheric Science from State University of New York at Albany; an MS in Physics from Indiana State University; and a BS in Physics from Nanjing University, China. (RFP, Section IV.B.3.)

**Role and Responsibilities:** Ms. Wei will participate in the review of the mercury emissions inventory and will be responsible for the processing of any new emission inventories for modeling. Ms. Wei will also set up and conduct the application of AERMOD. (RFP, Section IV.B.3.)

### Belle Hudischewskyj

**Summary of Qualifications and Experience:** Ms. Belle Hudischewskyj is a Senior Associate with ICF and a trained meteorologist with 27 years of experience in the areas of meteorological and air quality data analysis and modeling. Ms. Hudischewskyj specializes in the analysis and quality assurance of meteorological and air quality data. Ms. Hudischewskyj has extensive experience in the use of statistical data analysis techniques and, in particular, the application of CART. She was a key participant in the VISTAS meteorological characterization study and was responsible for data preparation and quality assurance for the CART application for the VISTAS PM<sub>2.5</sub> and regional haze data analysis study. Ms. Hudischewskyj also conducted the several recent CART applications for mercury. (RFP, Section IV.B.3.)

Ms. Hudischewskyj is also experienced in meteorological modeling and the preparation of meteorological inputs for air quality modeling. She applied and evaluated MM5 for the GCOS/CIAP, WFOS, and ATMOS studies and is currently involved in the application of MM5 for other areas. Ms. Hudischewskyj is knowledgeable in a variety of database management tools such as DBMS and MS-Access. Ms. Hudischewskyj has a B.S. degree in Meteorology from San Jose State University.

**Role and Responsibilities:** Ms. Hudischewskyj will be responsible for acquiring, reviewing, and coordinating all handling of the air quality and meteorological data required for this study. She will participate in the CART analysis and will prepare the meteorological inputs for application of the Gaussian model. (RFP, Section IV.B.3.)

### Boddu Venkatesh

**Summary of Qualifications and Experience:** Dr. Boddu Venkatesh is currently a Principal at ICF in the Energy Markets group. He is a versatile systems engineer with strong analytical and computer skills. He has good knowledge of applying systems and operations research tools to complex problems. Energy and environmental analyses have been his area of focus. At ICF, Dr. Venkatesh has been primarily involved with supporting U.S. EPA, Environment Canada, RPO's and other clients with IPM<sup>®</sup> based analytical work in regards to electric sector environmental compliance planning for NO<sub>x</sub>, SO<sub>2</sub>, CO<sub>2</sub> and Mercury. He has also managed the Environmental Assessment for the FERC Order 2000. Dr. Venkatesh has in the past helped evaluate the value of power plant assets and was the lead analyst involved in developing the ICF's Bulk Power Outlook 1999. He has developed methodologies for incorporating industrial boilers and advanced emission-banking structures into IPM. (RFP, Section IV.B.3.)

Dr. Venkatesh received MS and PhD degrees in Systems Engineering from Case Western Reserve University in Cleveland. (RFP, Section IV.B.3.)

**Role and Responsibilities:** For this analysis, Dr. Venkatesh will participate in the emission inventory review work (Section A) and in the future-year emission inventory development (Section B) of the study. (RFP, Section IV.B.3.)

#### Tim Lavallee, P.E.—LPES, Inc.,

**Summary of Qualifications and Experience:** Tim Lavallee, President/Senior Engineer of LPES has more than a decade of experience in project management and engineering in the air quality field. Mr. Lavallee holds a master's degree from Tufts University in civil engineering/environmental health, and a bachelor's degree from Northeastern University in mechanical engineering. Before founding LPES, Mr. Lavallee managed an environmental firm's air-quality services branch and worked for Lockheed Martin Space Missions and Support Services. Mr. Lavallee is a member of the American Society of Civil Engineers and the Society of American Military Engineers. He has authored numerous professional and technical publications. He is well versed in air quality compliance and planning, noise prediction and control, and NEPA. (RFP, Section IV.B.3. and 6.)

**Roles and Responsibilities:** Mr. Lavallee will participate in the mercury emissions data analysis, where he will assist in reviewing and analyzing the point source mercury emissions inventory information compiled by VDEQ for industrial point sources for 2002 and 2005. (RFP, Section IV.B.3. and 6.)

#### Diane Shotynski—Thruput

**Summary of Qualifications and Experience:** Diane Shotynski, President and founder of Thruput, holds a B.S. in Civil Engineering from the University of Pennsylvania and has over 11 years experience in the environmental engineering field. She has held a variety of environmental engineering positions throughout the Mid-Atlantic region including work in the early 1990's for the Abingdon, VA office of the Virginia DEQ. She has worked on remediation projects in Maryland, processed stationary source air permits for VDEQ, and evaluated criteria and toxic emissions and modeled these emissions in impact studies for the City of Philadelphia. (RFP, Section IV.B.3. and 6.)

**Roles and Responsibilities:** Ms. Shotynski will participate in the mercury emissions data analysis, where she will assist in reviewing and analyzing the point source mercury emissions inventory information compiled by VDEQ for industrial point sources for 2002 and 2005. (RFP, Section IV.B.3. and 6.)

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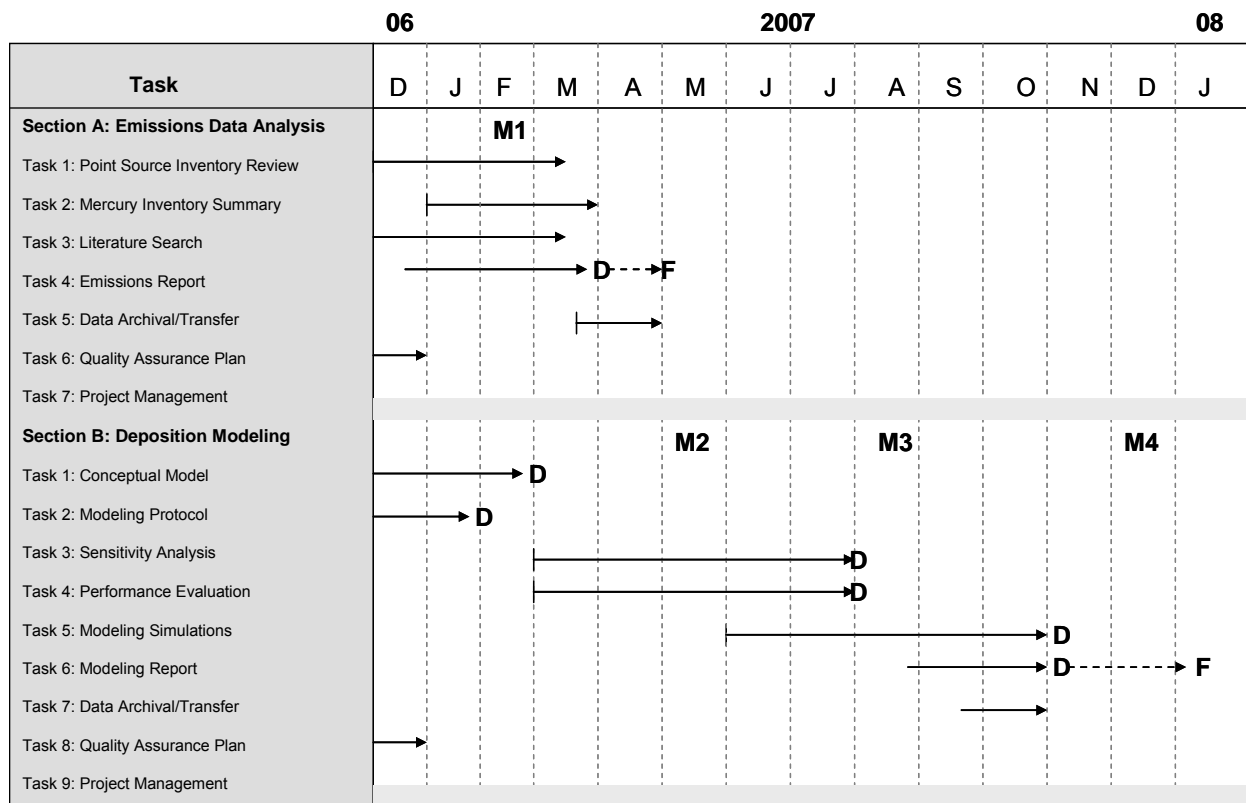
## 4. Schedule and Deliverables (RFP Sections IV.B.4, V.B.2)

In this section, we present a schedule and list of deliverables for the work outlined above for the Emissions Inventory Data Analysis (Section A) and Mercury Deposition Modeling (Section B). (RFP, Section VI.A.)

### Schedule

Figure 4-1 presents the schedule for conducting the technical tasks. The schedule assumes a project initiation date of 1 December 2006. (RFP, Section VI.A.)

**Figure 4-1. Proposed schedule for completing Parts A and B of the Virginia Mercury Study (shading represents ongoing activity).**



Key:  
**M1 – M4** = Project meetings  
**D** = Draft report (or draft protocol)  
**F** = Final report (or final protocol)

## Deliverables

The list of deliverables for work conducted under Parts A and B of the Virginia Mercury Study include the following: (RFP, Section VI.A.)

### ***Part A—Mercury Emissions Data Analysis***

- Work plan to guide the mercury emissions data analysis
- Mercury emissions review summary (technical memorandum)
- Mercury emissions inventory summary (technical memorandum)
- Literature review summary (technical memorandum)
- Mercury emissions data analysis report (draft and final versions)
- Mercury emissions data files
- Quality assurance project plan
- Monthly progress reports

### ***Part B—Mercury Deposition Modeling***

- Work plan to guide the mercury deposition modeling
- Conceptual model summary (technical memorandum)
- Modeling protocol (draft and final versions)
- Model sensitivity analysis summary (draft technical memorandum)
- Model performance evaluation summary (draft technical memorandum)
- Mercury deposition modeling report (draft and final versions)
- Modeling output files
- Quality assurance project plan
- Monthly progress reports

## 5. Client Reference Form and Past Performance Summaries (RFP Section IV.B.2, Attachment D)

In this section, we present information regarding current or recent clients and studies conducted by the project team that are related to the work called for in the RFP in the areas of emission inventories, air quality data analysis, and mercury deposition modeling. For each client contact listed in the Vendor Data Sheet, we provide a complete description of the study in the order listed in the table. Additional project descriptions for other related studies are also included at the end of this section. (RFP, Section V.B.3)

### Attachment D: Vendor Data Sheet

1. Qualification: The vendor must have the capability and capacity in all respects to satisfy fully all of the contractual requirements.
2. Vendor's Primary Contact:

Name: Jay L. Haney, Vice President Phone: 415-507-7164

3. Years in Business: Indicate the length of time you have been in business providing this type of good or service: 35 Years 10 Months

4. Vendor Information:

FIN or FEI Number: 54-1500263 If Company, Corporation, or Partnership

Social Security Number: \_\_\_\_\_ If Individual

5. Indicate below a listing of at least four (4) current or recent accounts, either commercial or governmental, that your company is servicing, has serviced, or has provided similar goods. Include the length of service and the name, address, and telephone number of the point of contact.

A. Company: EPA Office of Water Contact: Dwight Atkinson  
 Phone: (202)-566-1226 Fax: (202)-566-1333  
 Project: Modeling of Mercury Deposition Contributions from US Sources  
 Dates of Service: November 2005 - present \$ Value: 350 K

B. Company: EPA Office of Water Contact: Dwight Atkinson  
 Phone: (202)-566-1226 Fax: (202)-566-1333  
 Project: Modeling of Nitrogen, Mercury, and Other Toxics for the EPA Office of Water (multiple tasks)  
 Dates of Service: 1995 - 2005 \$ Value: 750 K

- C. Company: EPA OAQPS Contact: Tom Braverman  
 Phone: (919)-541-5383 Fax: (919)-541-0044  
 Project: Incorporation of Mercury, Sulfur, and Nitrogen Tagging into the CMAQ Modeling System  
 Dates of Service: February 2005 - present \$ Value: 55 K
- D. Company: EPA Office of Water Contact: Dwight Atkinson  
 Phone: (202)-566-1226 Fax: (202)-566-1333  
 Project: Application of the REMSAD Modeling System to Estimate the Deposition of Mercury in Support of the Wisconsin TMDL Pilot Study  
 Dates of Service: 1995 - 2003 \$ Value: 250 K
- E. Company: EPA Region III Contact: Francis J. Mulhern  
 Phone: (214) 655-6644 Fax: (214)-655-XXXX  
 Project: Air Deposition Modeling to Support Mercury TMDL Analyses for Maryland  
 Dates of Service: January – October 2004 \$ Value: 65 K
- F. Company: EPA Region VI Contact: Phillip Crocker  
 Phone: (215) 665-6644 Fax: (215)-665-6644  
 Project: Air Deposition Modeling to Support Mercury TMDL Analyses for Southern Louisiana  
 Dates of Service: January – August 2004 \$ Value: 42 K
- G. Company: EPA Office of Policy, Economics, and Innovation Contact: Greg Miller  
 Phone: (202) 566-2310 Fax: (202) 566-2310  
 Project: Technical Support to EPA Workgroup on the Clean Air Mercury Rule  
 Dates of Service: August 2004 – March 2005 \$ Value: 210 K

- |    |                   |   |           |                        |
|----|-------------------|---|-----------|------------------------|
| H. | Company:          | <u>EPA Office of Air Quality<br/>Planning and Standards</u>   | Contact:  | <u>Martha Keating</u>  |
|    | Phone:            | <u>(919)-563-3223</u>   | Fax:      | <u>(919)-563-3223</u>  |
|    | Project:          | <u>Compilation of the Mercury Study Report to Congress</u>  |           |                        |
|    | Dates of Service: | <u>August 1994 – December<br/>1997</u>  | \$ Value: | <u>240 K</u>           |
|    |                   |   |           |                        |
| I. | Company:          | <u>EPA Office of Air Quality<br/>Planning and Standards</u>   | Contact:  | <u>Deirdre Murphy</u>  |
|    | Phone:            | <u>(919)-541-0729</u>   | Fax:      | <u>(919)-541-0729</u>  |
|    | Project:          | <u>TRIM.FaTE Mercury Test Case Development, Application, and<br/>Analysis</u>   |           |                        |
|    | Dates of Service: | <u>October 1999 – July<br/>2005</u>   | \$ Value: | <u>1.1 M K</u>         |
|    |                   |   |           |                        |
| J. | Company:          | <u>US Dept of Energy</u>  | Contact:  | <u>Mark Vandenberg</u> |
|    | Phone:            | <u>(702) 794-1367</u>   | Fax:      | <u>(702) 794-1367</u>  |
|    | Project:          | <u>AERMOD Analysis for the Construction and Operation of a 320-Mile<br/>Rail Line for the Yucca Mountain Repository</u> |           |                        |
|    | Dates of Service: | <u>September 2005 – June<br/>2006</u>   | \$ Value: | <u>30 K</u>            |
|    |                   |   |           |                        |
| K. | Company:          | <u>US EPA OTAQ</u>  | Contact:  | <u>Chad Bailey</u>     |
|    | Phone:            | <u>(734) 214-4954</u>   | Fax:      | <u>(734) 214-4954</u>  |
|    | Project:          | <u>AERMOD Modeling of Project-Level Particulate Matter Impacts of<br/>Motor Vehicle Transportation</u>                  |           |                        |
|    | Dates of Service: | <u>January – September<br/>2005</u>   | \$ Value: | <u>80 K</u>            |
|    |                   |   |           |                        |
| L. | Company:          | <u>EPA Clean Air Markets Division</u>   | Contact:  | <u>Sam Napolitano</u>  |
|    | Phone:            | <u>202 343 9150</u>   | Fax:      | <u>202 343 9150</u>    |
|    | Project:          | <u>Support for Market-Based Air Emissions Control Programs</u>  |           |                        |
|    | Dates of Service: | <u>April 2003 - present</u>   | \$ Value: | <u>\$35 M</u>          |

M	Company:	Western Governor's Association/ Western Regional Air Partnership (WRAP)	Contact:	Rich Halvey
	Phone:	(303) 623-9378	Fax:	(303) 623-9378
	Project:	Estimation of SO <sub>2</sub> emissions for the Western States for Regional Haze Assessments		
	Dates of Service:	July 2001 – November 2002	\$ Value:	\$300 K
N.	Company:	MARAMA	Contact:	Bill Gillespie
	Phone:	410-467-0170	Fax:	410-467-1737
	Project:	PM <sub>2.5</sub> Forecasting Assistance for the Mid-Atlantic States		
	Dates of Service:	March 2003 to June 2005	\$ Value:	166 K
O.	Company:	Southern Company	Contact:	John Jansen
	Phone:	205-257-7698	Fax:	205-257-7294
	Project:	CMAQ Modeling for the Southeastern US (VISTAS Region)		
	Dates of Service:	October 2004 - present	\$ Value:	350 K
P.	Company:	SESARM - VISTAS	Contact:	Pat Brewer
	Phone:	(828) 296-4500	Fax:	828-299-7043
	Project:	Characterization of Meteorology and Its Relationships to Fine Particulate Mass and Visibility in the VISTAS Region		
	Dates of Service:	September 2003 to present	\$ Value:	325 K
Q.	Company:	EPA Office of Research and Development, National Center for Environmental Research	Contact:	Mary Wigginton
	Phone:	(202)-343-9861	Fax:	(202)-343-9861
	Project:	Synthesis Report of Research Results from FY99 STAR Mercury Grants		
	Dates of Service:	November 2003 - present	\$ Value:	45 K

R.	Company:	<u>SESARM – Gulf Coast States</u>	Contact:	<u>Tom Rogers</u>
	Phone:	<u>850-921-9554</u>	Fax:	<u>850-922-6979</u>
	Project:	<u>The Gulf Coast Ozone Study (GCOS)</u>		
	Dates of Service:	<u>January 1999 – April 2005</u>	\$ Value:	<u>820 K</u>
S.	Company:	<u>Arkansas, Tennessee, and Mississippi</u>	Contact:	<u>Mark McCorkle</u>
	Phone:	<u>501-682-0736</u>	Fax:	<u>501-682-0753</u>
	Project:	<u>The Arkansas-Tennessee-Mississippi Ozone Study (ATMOS)</u>		
	Dates of Service:	<u>January 1999 – April 2005</u>	\$ Value:	<u>680 K</u>

I certify the accuracy of this information.

Signed: Jay L. Haney Title: Vice President Date: \_\_\_\_\_

In the order presented in the table above, below we provide corresponding summaries for the current or recently completed studies that substantiate our qualifications and experience in the areas of mercury modeling, CMAQ modeling, mercury assessment studies, AERMOD modeling, air quality data analysis, and regional air quality modeling for PM and ozone. (RFP, Section V.B.3.)

## Modeling of Mercury Deposition Contributions from U.S. Sources

**Client:** U.S. EPA, Office of Water

**Client Contact:** Dwight Atkinson, (202)-566-1226 [Atkinson.Dwight@epamail.epa.gov](mailto:Atkinson.Dwight@epamail.epa.gov)  
EPA Office of Water (OW), Ariel Rios Building (4503-T), 1200 Pennsylvania Avenue, NW, Washington, DC, 20004

**Contract Period:** November 2005–present

Beginning in 1993, the Regional Modeling System for Aerosols and Deposition (REMSAD) was developed by ICF for the EPA. Development and enhancement of the model has continued over the years resulting in a state-of-the-science, one-atmosphere model. REMSAD includes a detailed treatment of the emission, transformation, transport, and re-emission of mercury. A major development for the model was addition of the Particle and Precursor Tagging Methodology (PPTM) that allows contributions of emissions sources to air concentrations and deposition to be estimated. In this project, the PPTM was used to estimate contributions to mercury deposition from approximately 300 individual sources and sources categories within the U.S.

Major components of this project include:

- Evaluate alternative meteorological data sets available for mercury simulations.
- Review the U.S. emissions inventory, including collection of comments from EPA regions and individual states.
- Select sources to be tagged, with input from EPA regions and states.
- Conduct annual simulations for the calendar year 2001 with REMSAD to estimate contributions to mercury deposition from the selected U.S. source tags, Canada, Mexico, and global contributions.
- Conduct a CMAQ simulation for a subset of the tags (using the PPTM recently implemented in CMAQ by ICF) for comparison with the REMSAD results.
- Document the study and provide analysis of results in a final report.
- Provide model estimates of mercury deposition for inclusion in a nationwide database of mercury deposition.

The simulation results cover the entire U.S. at a resolution of 12 km and allow the estimation of the major contributors in watersheds within the U.S. Several sources in Virginia, for instance, were tagged allowing the estimation of contributions to deposition from the Chesterfield Power Station, the NASA Refuse-fired Steam Generator, the Chesapeake Energy Center, the Norfolk Navy Yard, the Jewel Coke Company, and other Virginia sources collectively. In addition, the magnitude of contributions of sources outside Virginia to deposition of mercury in Virginia can be evaluated using the information on sources tagged in other states.

Analysis of the simulation results and use of the modeled data in a GIS system will allow estimates to be made of contributions to mercury deposition from each of the tagged sources to watersheds throughout the U.S.

## Modeling of Nitrogen, Mercury, and Other Toxics for the EPA Office of Water

**Client:** U.S. EPA, Office of Water

**Client Contact:** Dwight Atkinson, (202)-566-1226 [Atkinson.Dwight@epamail.epa.gov](mailto:Atkinson.Dwight@epamail.epa.gov)  
EPA Office of Water (OW), Ariel Rios Building (4503-T), 1200 Pennsylvania Avenue, NW, Washington, DC, 20004

**Contract Period:** November 1995 – 2005

Starting in 1993, the REMSAD modeling system was developed by ICF for the U.S. EPA Office of Policy, Planning, and Evaluation to support a better understanding of the distributions, sources, and removal processes relevant to particulate matter and other airborne pollutants, including soluble acidic components and toxics. The REMSAD modeling system was originally developed as part of Phase I of the Great Waters Impact Assessment Study (GWIAPS).

REMSAD was applied for the EPA Office of Water to the conterminous U.S. at approximately 36-km resolution with selected areas of the domain at 12-km resolution. Emphasis was on estimation of deposition of nitrogen species and mercury, but calculations were also made for dioxins, POM, particulate matter, and cadmium. Because of the efficiency of the chemical mechanism, annual simulations of the entire U.S. were practical. Under this work assignment, a system for tracking mercury to point of deposition was added. This methodology is referred to

as the Particle and Precursor Tagging Methodology (PPTM). A number of improvements recommended in a peer review of REMSAD were incorporated into the model during this project. A detailed and up to date treatment of mercury chemistry is now included in the model. REMSAD now makes use of more meteorological information that is available from the output of the meteorological model. Aqueous phase oxidation of SO<sub>2</sub> now includes reactions with ozone and molecular oxygen in addition to peroxide. The simulated air concentrations of sulfate and nitrate and other species were evaluated against monitoring data from the IMPROVE, CASTNET and AIRS databases. In addition, the simulated deposition of nitrate and sulfate were evaluated against data from the National Acid Deposition Program (NADP) and good model performance was achieved. In the remainder of the project, simulations were conducted for toxic species including mercury. Results of the mercury modeling were used to help estimate the potential mercury loading of water bodies via air deposition.

In a companion project, ICF extended PPTM to include nitrogen tagging in REMSAD that allows the fate of nitrogen emissions to be traced. The methodology allows the contributors to deposition at a given point in the domain to be tallied up and summarized. The current implementation allows nitrogen to be labeled for four different categories or areas in the domain. ICF completed simulations with REMSAD using the nitrogen tagging feature to follow emissions from each of the 48 coterminous states. A series of simulations were conducted and emissions from each of the lower 48 states, Canada, Mexico, and boundary concentrations were tagged. The results of the simulations were used to estimate the contribution of the emissions from each state to deposition of nitrogen at locations throughout the domain, and to identify the emissions sources that contribute to deposition in selected watersheds.

## Incorporation of Mercury, Sulfur and Nitrogen Tagging in the CMAQ Modeling System

**Client:** U.S. EPA, Office of Air Quality Planning and Standards

**Client Contact:** Tom Braverman, (919) 541-5383, [braverman.tom@epa.gov](mailto:braverman.tom@epa.gov)  
Research Triangle Park, NC

**Contract Period:** February 2005–present

In this project, we enhanced the CMAQ modeling system to include mercury, sulfur, and nitrogen tagging in order to improve the utility of the modeling system for the study of mercury and fine particulate matter (PM<sub>2.5</sub>) and the identification of effective control strategies. This methodology is designed to provide detailed, quantitative information about the *contribution* of selected sources, source categories, and/or source regions to simulated mercury and PM<sub>2.5</sub> concentrations. Emissions of mercury, sulfur (primarily sulfur dioxide (SO<sub>2</sub>) and primary sulfate) and nitrogen compounds (primarily oxides of nitrogen (NO<sub>x</sub>)) from selected sources, source categories, or source regions are (numerically) tagged and then tracked throughout a simulation. The contribution from each tag to the resulting simulated concentration or deposition of mercury, PM<sub>2.5</sub>, or their component species for any given location can be quantified. By tracking the emissions from selected sources or source locations, the methodology also provides information on the fate of the emissions from these sources. Mercury, sulfur, and nitrogen tagging have been implemented as part of the CMAQ Particle and Precursor Tagging Methodology (PPTM).

One part of this study focused on the application for mercury. Tags were applied to electric generation sources (EGUs), all other mercury sources within the domain, and initial and boundary conditions (IC/BCs). The results indicate that the initial and boundary conditions comprise a significant part of the total deposition. EGU emissions contribute most to dry

deposition of mercury in the mid-Atlantic states during this simulation period. Wet deposition is strongly influenced by the amount of rainfall during the simulation period.

Another aspect of this study focused on sulfur tagging, and specifically SO<sub>2</sub> and particulate sulfate emissions from pulp and paper manufacturing facilities. This industry sector was identified by EPA for this analysis because the future-year (2010) emissions are expected to be among the highest of non electric generating unit emissions categories, based on the Clean Air Interstate Rule (CAIR) modeling conducted by EPA. In total, tags were applied to 10 facilities and the contributions of the emissions from these facilities to simulated sulfate and PM<sub>2.5</sub> concentrations were quantified using the CMAQ PPTM methodology.

### Application of the REMSAD Modeling System to Estimate the Deposition of Mercury in Support of the Wisconsin TMDL Pilot Study

**Client:** U.S. EPA, Office of Water

**Client Contact:** Dwight Atkinson, (202)-566-1226 [Atkinson.Dwight@epamail.epa.gov](mailto:Atkinson.Dwight@epamail.epa.gov)  
EPA Office of Water (OW), Ariel Rios Building (4503-T), 1200 Pennsylvania Avenue, NW, Washington, DC, 20004

**Contract Period:** November 1995 – July 2003

In this study, ICF conducted REMSAD modeling to provide information for evaluating the environmental consequences of alternative control strategies for reducing mercury deposition to designated areas under evaluation by the Mercury Total Maximum Daily Load (TMDL) Pilot Project. For the pilot study, Devil's Lake in Wisconsin was chosen as the site for evaluation of the processes leading to elevated mercury levels in fish inhabiting the lake. REMSAD was used to provide quantitative estimates of wet and dry deposition of mercury to the lake. The deposition value were subsequently used for water modeling, in order to evaluate the long-term outlook for the mercury loading in the lake and the effect on wildlife.

The REMSAD modeling domain encompassed the coterminous U.S. and parts of Canada and Mexico. Meteorological data for the application was derived from the Rapid Update Cycle (RUC) forecast and analysis system maintained by NCAR. A 1996 mercury emissions inventory was used. In order to estimate contributions from specific sources to mercury deposition in Wisconsin, we used the Particle and Precursor Tagging Methodology (PPTM), in which the mercury emissions from specific sources or source types are tagged and track within the model. An annual simulation was conducted with REMSAD, and simulated wet deposition results were evaluated against data from the Mercury Deposition Network (MDN).

For this study, we estimated the contributions from utilities, industrial boilers, chlor-alkali plants, medical waste incinerators, municipal waste incinerators, and other source categories (collectively) within Wisconsin to the simulated deposition at Devil's Lake. We also examined the contributions from a number of neighboring states.

As part of this study, we also analyzed the potential year-to-year variability in mercury deposition. We employed Classification and Regression Tree (CART) along with the annual REMSAD simulation results in order to estimate mercury deposition for a ten-year period, based on the frequency of occurrence of meteorological conditions and their relationship to mercury deposition. EPA then used these values for water quality modeling and estimating fish tissue concentrations

## Air Deposition Modeling to Support Mercury TMDL Analyses for Maryland

**Client:** U.S. EPA, Region 3

**Client Contact:** Francis J. Mulhern, (214) 655-6644 [Mulhern.Francis@epamail.epa.gov](mailto:Mulhern.Francis@epamail.epa.gov) EPA Region 3, 1650 Arch St., Philadelphia PA 19103

**Contract Period:** January 2004–October 2004

In this study, ICF conducted mercury deposition modeling in order to estimate air deposition of mercury within the state of Maryland. The modeling results were used by EPA Region 3 in developing a new Total Maximum Daily Load (TMDL) estimate for mercury in Maryland. The REMSAD model, developed in work for EPA Office of Water (OW), was used for this study. It includes the Particle and Precursor Tagging Methodology (PPTM) which allows tagging of emissions (a way of estimating the contribution of emissions to deposition).

Meteorological data files developed in other work for the EPA Office of Water were utilized in this study. Emissions were based on a 1996 inventory available from EPA OAQPS. The simulation was conducted for a full year using a 36-km domain for the continental scale, and a nested domain at 4-km resolution covering Maryland.

Tags for several sources and categories of sources were defined. These included individual medical waste incinerators, municipal waste combustors, minerals processing, utility sources, and other emissions in Maryland. In addition, emissions from several neighboring states were tagged as a whole. A summary of simulated estimates of contributors to mercury deposition was provided in the final report.

Using a Classification and Regression Tree (CART) technique, an estimate was developed of the potential year-to-year variability in deposition estimates. The technique combined the annual REMSAD simulation results with the long term meteorological record to provide a statistical analysis of the expected range in deposition estimates based on the variability in meteorology.

Emissions inventory files, REMSAD input files, the REMSAD model, and the EPS2.5 emissions processing software were transferred to Region 3 so that staff there could conduct additional simulations. ICF also provided training sessions on the use of REMSAD and the EPS software.

## Air Deposition Modeling to Support Mercury TMDL Analyses for Southern Louisiana

**Client:** EPA Region 6

**Client Contact:** Phillip Crocker, (215) 665-6644 [Crocker.Philip@epamail.epa.gov](mailto:Crocker.Philip@epamail.epa.gov) EPA Region 6, 1445 Ross Avenue, Suite 1200 Dallas, TX 75202

**Contract Period:** January 2004–August 2004

In this project, ICF conducted modeling for EPA Region 6 to estimate air deposition of mercury to Louisiana gulf coastal basins. These estimates were used by EPA Region 6 to develop Total Maximum Daily Load (TMDL) estimates for mercury in the gulf coastal water basins of Louisiana.

ICF utilized the REMSAD model, developed in work for EPA Office of Water (OW), to provide estimates of air deposition of mercury to the coastal basins. The REMSAD model includes the

Particle and Precursor Tagging Methodology (PPTM) which allows tagging of emissions (a way of estimating the contribution of emissions to deposition).

Meteorological data files developed in other work for EPA Office of Water were utilized in this study. Emissions were based on a 1996 inventory available from EPA OAQPS. In this study, updates were made to the inventory based on a review conducted in cooperation with EPA Region 6. The review included comparisons of inventory data with mercury emissions estimates from the Toxic Release Inventory (TRI) and from the Toxic Emissions Data Inventory (TEDI), both representing 2001 emissions levels. ICF ran an annual simulation of mercury deposition using a 36-km grid for the continental scale domain. A nested grid at 4-km resolution was included that covered southern Louisiana.

Tags for several sources and categories of sources were defined. These included individual utility sources, smaller utility sources (collectively), chlor-alkali plants, medical waste incinerators, and other emissions in Louisiana. An analysis of the contributions of the tagged sources to deposition in the coastal zone was provided in the final report. In addition, Region 6 staff were provided with output files detailing the deposition estimates from REMSAD.

### Technical Support to EPA Workgroup on the Clean Air Mercury Rule

**Client:** U.S. EPA, Office of Policy, Economics, and Innovation

**Client Contact:** Greg Miller, (202)-566-2310 [miller.gregory@epa.gov](mailto:miller.gregory@epa.gov)  
EPA Office of Policy, Economics, and Innovation (OPEI), Ariel Rios Building,  
Mail Code 1809T, 1200 Pennsylvania Avenue, NW, Washington, DC, 20460

**Contract Period:** August 2004–March 2005

ICF provided support to EPA/OPEI in the development of the Clean Air Mercury Rule power plants (finalized March 2005). This complex and contentious rule was focused on reducing mercury emissions from utilities nationwide. ICF's primary role in supporting the preparation of the Regulatory Impact Analysis (RIA) for this rule included collecting and synthesizing technical data used in the exposure analyses supporting the rule, including qualitative and quantitative data on fish consumption, mercury levels in fish, fish consumption advisory effectiveness, the lifecycles and commercial sources of fish containing relatively high levels of mercury, and other related scientific topics. ICF also developed comprehensive, concise summaries of the human health and ecological effects of mercury for EPA that were incorporated into RIA Chapter 2 and several supporting appendices. In addition, at the beginning of EPA's efforts to develop the RIA, ICF coordinated a multi-session EPA workshop focused on the state of the science in mercury risk and benefits assessment for all EPA staff involved with this rule development effort.

ICF also developed summary tables, text, graphics, and other materials for OPEI staff to use in presenting policy options to the EPA Administrator's office and in seminars designed to relay scientific information to members of the press. ICF's efforts were commended by the client for their completion of high-quality deliverables within the extremely tight time-frame required as a part of this rule development process.

### Compilation of the Mercury Study Report to Congress

**Client:** U.S. EPA, Office of Air Quality Planning and Standards

**Client Contact:** Martha Keating, (919)-563-3223  
Recently left EPA OAQPS

**Contract Period:** August 1994–December 1997

Section 112(n)(1)(B) of the Clean Air Act, as amended in 1990, required EPA to submit a study on atmospheric mercury emissions to Congress. Congress directed that the mercury study evaluate many aspects of mercury emissions, including the rate and mass of emissions, health and environmental effects, technologies to control such emissions, and the costs of such controls. In response to this mandate, EPA published an eight-volume Mercury Study Report to Congress in December 1997 (EPA-452/R-97-003). The eight volumes included an inventory of anthropogenic mercury emissions in the U.S., comprehensive information on mercury fate and transport and health effects, human health and ecological exposure assessments for mercury and associated risk characterizations, and an evaluation of mercury control technologies and costs.

ICF supported the preparation of this report by conducting research and preparing written materials on a variety of subjects. For Volume II, ICF worked with the lead EPA authors and contributors to develop the comprehensive inventory of anthropogenic mercury emissions in the U.S. For Volume III, Fate and Transport of Mercury, ICF supplemented text from EPA scientists with information from literature searches. ICF also prepared the problem formulation components of the ecological assessment included in Volume VI. This included an analysis and summary of mercury speciation and cycling in the environment, bioaccumulation processes, potential exposure pathways in terrestrial and aquatic systems, and potential effects of mercury on individuals, communities, and ecosystems. As part of this ecological assessment, ICF prepared geographic information system maps that overlaid the range of certain species susceptible to mercury exposure and effects (e.g., the endangered Florida Panther and certain piscivorous birds and mammals) with model projections of mercury deposition rates across the U.S.

For inclusion in Volume VIII, ICF prepared an analysis of the social costs of mercury pollution and a framework for assessing the benefits of reduced mercury emissions. This analysis included a summary of the costs and values associated with fisheries potentially affected by mercury contamination, including the commercial fishing values, recreational fishing values, and subsistence and cultural values. To support the preparation of Volume V, ICF reviewed and summarized the literature on human health effects associated with mercury. This included literature on the toxicokinetics and biological effects of mercury and mercury compounds, as well as available hazard identification and dose response assessments.

ICF also provided document compilation and preparation support for the entire report. This support included assembling various pieces of the study prepared by different authors into single volumes, preparing graphics and tables, organizing and writing introductory and connecting sections, and revising the different volumes in response to reviewer comments.

## TRIM.FaTE Mercury Test Case Development, Application, and Analysis

**Client:** U.S. EPA, Office of Air Quality Planning and Standards

**Client Contact:** Deirdre Murphy, (919)-541-0729 [murphy.deirdre@epa.gov](mailto:murphy.deirdre@epa.gov)  
EPA Office of Air Quality Planning and Standards, Research Triangle Park,  
NC 27711

**Contract Period:** June 2000–July 2005

In conjunction with the development and testing of EPA's TRIM.FaTE multimedia chemical fate and transport and ecological exposure model, ICF designed, parameterized, and implemented a

test application of the model to assess mercury emissions from a chlor-alkali facility. The simulation modeled 30 years of divalent and elemental mercury emissions from the facility, estimated near-source deposition to watershed soils, lakes, and a river within a region of approximately 125 km<sup>2</sup>, and simulated mercury intermedia transfer, intramedia transformation, and uptake by biota. The mass balance approach used in TRIM.FaTE, including mercury transformations in various environmental media and types of biota, ensured that the predicted distribution of mercury in the environment reflects the total mercury available. TRIM.FaTE's mass balance approach incorporates fugacity principles, deriving from and building on the CALTOX model and the earlier modeling formulations of Mackay Level 1, 2, and 3 partitioning models and the chemodynamics concepts developed by Thibodeaux.

For the mercury test case, TRIM.FaTE was applied to provide time-series and spatially resolved predictions of mercury mass and concentration in environmental media and biota. Results were observed to be consistent with expectations based on the algorithms used, which were derived from what is currently known about mercury fate and transport. Predicted TRIM.FaTE mercury concentrations and speciation results compared reasonably well with modeling results derived using 3MRA (another EPA model), limited measurement data for the test case site, and reports from the literature. Summary results and evaluation conclusions were summarized in the 2005 Volume 2 of the TRIM.FaTE Evaluation Report (Model Performance Focusing on Mercury Test Case), prepared by ICF for EPA and available on-line at [http://www.epa.gov/ttn/fera/trim\\_fate.html](http://www.epa.gov/ttn/fera/trim_fate.html).

## AERMOD Analysis for the Construction and Operation of a 320-Mile Rail Line for the Yucca Mountain Repository

**Client:** U.S. Department of Energy

**Client Contact:** Mark Vandeberg, (702) 794-1367  
Office of Civilian Radioactive Waste Management, Bureau of Reclamation  
1551 Hillshire Drive, Las Vegas, Nevada

**Contract Period:** September 2005 – June 2006

For the U.S. DOE, ICF lead the technical analysis for the air quality impacts associated with the construction, operation, and ancillary support facilities for this new rail project. The effort has included the development of an emission inventory associated with both the operation and construction of the new rail line. The project assessed the impact for various alternative alignments. The emission inventory assessment include an analysis of emissions from the end of the rail line, fleet management facility, transportation operation center and the UP interchange facility. Air quality impacts were modeled using AERMOD for several communities located in close proximity to the alignment as well at several of the ancillary facilities located near communities along the rail line. ICF also provided recommendations on mitigation strategies associated with the construction phase to reduce fugitive dust emissions as well as the use of new technology rail locomotives to reduce idling diesel emissions.

## AERMOD Modeling of Project-Level Particulate Matter Impacts of Motor Vehicle Transportation

**Client:** U.S. EPA, Office of Transportation and Air Quality

**Client Contact:** Chad Bailey, Project Manager, U.S. EPA, (734) 214-4954 Office of Transportation and Air Quality, AAATC USEPA National Vehicle and Fuel Emissions Laboratory/OAR, 2565 Plymouth Road, Ann Arbor, MI 48105

**Contract Period:** January - September 2005

For EPA's Office of Transportation and Air Quality, ICF completed a study that: 1) summarized the properties of motor vehicle exhaust and non-exhaust PM emissions that are needed in running dispersion models, including particle size distribution and deposition velocity, 2) evaluated the capabilities of a wide variety of several air dispersion models (CALINE3, CALINE4, CAL3QHC/R, HYROAD, AERMOD, ISC3, and CALPUFF) in various transportation-related settings and provided recommendations for their use in the transportation project analysis (including transit bust garages and intermodal terminals), and 3) conducted a case study of how to apply air quality and emission factor models in predicting local concentrations of PM<sub>10</sub>, PM<sub>2.5</sub>, and air toxics using AERMOD and conducted a site-specific model evaluation. The application used a temperature adjustment factor for extended idling from heavy duty diesel trucks. The work also examined what the impacts may be from applying MOVES-like anticipated modal PM emission factors in the nearby roadway intersection vicinity and along a freeway on-ramp. The results were evaluated against data collected in the nearby roadway

### Support for Market-Based Air Emissions Control Programs

**Client:** U.S. EPA, Office of Air and Radiation, Clean Air Markets Division

**Contact:** Mr. Sam Napolitano, (202) 343 9150

**Period of Performance:** April 2003 to April 2008

In a follow-on contract, ICF is assisting with the development of the SO<sub>x</sub> and NO<sub>x</sub> emissions trading programs under the CAAA Title IV, and assisting in projecting the costs and emissions impacts of the SIP. ICF conducts statistical, economic, financial, technical, engineering, and evaluative analyses; and develops communication, outreach, guidance, and program support materials. We estimate costs, economic impacts, temporal, and spatial distribution of emissions, impacts on small business, and impacts on state and local government; model mercury emissions from utility boilers and developing emissions estimates; and perform fate and transport modeling for a base case and policy options, and pollutants legislative analysis including estimates of costs and emissions reductions, fate and transport modeling, and benefits estimates. Specific tasks related to this work include the recent Work Assignments to support EPA in the development and analysis of the Clean Air Rules of 2004 including the CAIR, CAMR, and CAVR proposals. ICF used its IPM to analyze alternative and final proposals for these rules, and generated the required unit level emissions data to support air quality and deposition modeling.

### Estimation of SO<sub>2</sub> emissions for the Western States for Regional Haze Assessments

**Client:** Western Governor's Association, Western Regional Air Partnership (WRAP)

**Contact:** Mr. Rich Halvey, (303) 623-9378

**Period of Performance:** July 2001 to November 2002

ICF conducted an economic impact assessment of a regional emissions cap for SO<sub>2</sub> in the Grand Canyon Visibility Transport Commission (GCVTC) region designed to protect visual

resources in the West. The program would include a market-based emissions trading program to be implemented only if the established emissions cap were exceeded. The goals of this study were to provide an assessment of the economic impacts of implementing the stationary source elements of the Regional Haze Regulations through command-and-control methods, including the application of Best Available Retrofit Technology (BART) requirements to all BART-eligible sources in the regions. In addition, the study provided an assessment of the regional economic impacts of the regulations implemented through a regional SO<sub>2</sub> emissions cap with a backstop market trading program, as provided in Section 309 of the Regional Haze Rule. The study assessed the direct impacts on the affected power and industrial sectors in terms of compliance costs, fuel market impacts, and operating costs.

For the regional economic analysis, ICF used the Policy Insight model of Regional Economic Models, Inc. (REMI®) to assess the economic impacts of SO<sub>2</sub> reduction policies in the nine GCVTC states. An eleven-region version of REMI, which included the 9 GCVTC states, a Tribal region and the rest of the country, was used for the WRAP analysis. ICF's Integrated Planning Model™ (IPM™) results for changes in electricity price, fuel costs, production costs, capital investments, revenues from permit allocation and coal market impacts were fed into REMI as direct impacts. Based on the REMI runs, state and tribal level impacts on employment, gross regional product (GRP) and personal income (PI) were analyzed. REMI runs for all four SO<sub>2</sub> trading options and the command-and-control strategies were implemented.

Follow-on work examined the role of renewables and energy efficiency in meeting the regional haze requirements. ICF modeled in detail the power sector and the interaction of these technologies with the system. Costs and emissions benefits were quantified. Regional economic impacts were also assessed.

## PM<sub>2.5</sub> Forecasting Assistance for the Mid-Atlantic States

**Client:** Mid-Atlantic Regional Air Management Association (MARAMA)

**Contact:** Mr. Bill Gillespie, 410-467-0170, [bgillespie@marama.org](mailto:bgillespie@marama.org), MARAMA, 711 W. 40<sup>th</sup> Street, Suite 312, Baltimore, Maryland 21211

**Period of Performance:** March 2003 to June 2005

The primary objective of this study was to develop and deliver documented and tested methods for forecasting PM<sub>2.5</sub> for several cities in the MARAMA region, including Newark, Wilmington, Philadelphia, Pittsburgh, Baltimore, Washington, Richmond, Roanoke, Bristol, and Charlotte. The specific tasks involved in preparing the CART-based PM<sub>2.5</sub> forecasting tool for each area of interest included (1) collecting and assembling meteorological and air quality data for the period 1999 through 2002, (2) setting up and applying CART using the historical data, (3) evaluating the CART results (with respect to accuracy and physical reasonableness), and (4) preparing a CART-based interactive forecasting tool and supporting documentation for each area of interest. The CART results were also used to develop a conceptual model of PM<sub>2.5</sub> for each area of interest and for the MARAMA region.

These projects highlight ICF's capabilities in the areas of data processing and evaluation, database management, CART analysis, and our understanding of the meteorology and air quality of the mid-Atlantic region.

## CMAQ Modeling for the Southeastern US (VISTAS Region)

**Client:** Southern Company

**Client Contact:** John Jansen, (205) 257-7698, [jjjansen@southernco.com](mailto:jjjansen@southernco.com)  
600 N. 18<sup>th</sup> St., Birmingham, Alabama, 35203

**Contract Period:** December 2004–present

ICF is currently assisting Southern Company in their participation in the VISTAS CMAQ modeling exercise that is being undertaken for regional haze and PM<sub>2.5</sub> planning and management in the southeastern U.S. Using modeling databases developed by VISTAS, we are conducting additional analyses using the 2002 annual database and future-year emission inventories for 2009 and 2018. In this study, we are applying CMAQ to investigate alternative emission reduction strategies for various Southern Company electricity generating units throughout the southeastern U.S. as part of the overall VISTAS regional haze/visibility assessment. This has involved manipulation and preparation of the emission inventories using the SMOKE emissions processor and using PAVE and other tools to view and analyze results. Multiple annual CMAQ sensitivity simulations have been completed. The results have been included in ADVISOR-PM tools for easy and efficient analysis.

## Characterization of Meteorology and Its Relationships to Fine Particulate Mass and Visibility in the VISTAS Region

**Client:** VISTAS

**Client Contact:** Pat Brewer, (828) 296-4500, [pat.brewer@ncmail.net](mailto:pat.brewer@ncmail.net)  
2090 U.S. 70 Highway, Swannanoa, NC 28778

**Contract Period:** September 2003–present

ICF is currently completing an analysis of the relationships between meteorology, PM<sub>2.5</sub> concentrations, and visibility for IMPROVE, SEARCH, and STN sites in the VISTAS region and surrounding areas. We have applied Classification and Regression Tree (CART) analysis using air quality and meteorological data for 2000-2004. We have used the CART results to develop an interactive database tool capable of addressing questions regarding (1) the different types of meteorological conditions that accompany PM<sub>2.5</sub> events (and good and poor visibility days), (2) the representativeness of selected episodic and annual simulation periods for VISTAS modeling, and (3) the selection of discrete multi-day periods for refined modeling or control-strategy evaluation. The conceptual design of the VISTAS meteorological and visibility characterization (and episode selection) tool is depicted in Figure 5-1 below.



and cycling in the environment, sources and distribution of mercury in terrestrial and aquatic systems, and bioavailability and bioaccumulation of mercury in aquatic systems.

The final synthesis report, completed in September 2005, involved addressing NCER's and other reviewers' comments on the draft report, graphically designing the report, and developing Adobe format versions in Web ready and high quality printing formats. The final 2005 report is available for use by EPA program managers and research staff as well as environmental scientists and professionals in the public realm.

## Gulf Coast Ozone Study (GCOS)

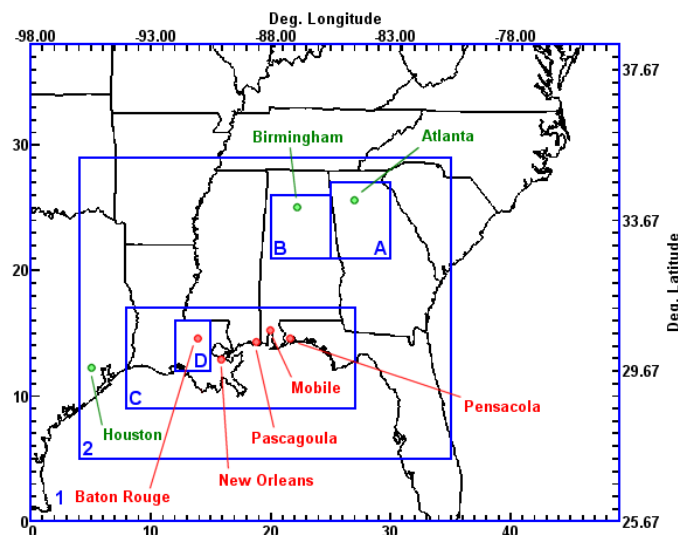
**Client(s):** Florida Department of Environmental Protection (FDEP), Alabama Department of Environmental Management (ADEM), Mississippi Department of Environmental Quality (MDEQ), Louisiana Department of Environmental Quality (LDEQ), and Southern Company

**Contact(s):** Mr. Thomas Rogers, 850-921-9554, [tom.rogers@dep.state.fl.us](mailto:tom.rogers@dep.state.fl.us), FDEP, 2600 Blair Stone Road, MS5500, Tallahassee, Florida 32399-2400

**Period of Performance:** January 1999 to April 2005

The objective of the GCOS data and modeling analysis was to provide technical information related to 8-hour ozone issues in the Gulf Coast area, and specifically to begin to develop a basis for meeting regulatory modeling requirements and for longer-term ozone air quality planning. The study included modeling protocol development, episode selection, emission inventory preparation, input preparation, model performance evaluation, and future-year modeling of the Gulf Coast area, which includes portions of Texas, Louisiana, Mississippi, Alabama, and Florida (see figure below).

**Figure 5-2. UAM-V Modeling Domain for the Gulf Coast Ozone Study (GCOS), with 36, 12, 4 and 2-km Resolution Nested Grids.**



The areas of interest included: Pensacola, Mobile, the Mississippi coastal counties, New Orleans, and Baton Rouge. The primary modeling tools applied for the GCOS modeling study include (1) the Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Model, Version 5 (MM5) for the preparation of meteorological inputs

and (2) the variable-grid Urban Airshed Model (UAM-V) for the simulation of ozone. The study also included the application of the Emissions Preprocessing System (EPS 2.5), MOBILE6 and BEIS-2 for the preparation of modeling emission inventories. Emissions were based on the NEI, and included updates from all states and offshore emissions from the MMS. The GCOS study included other participants such as EPA (Regions IV and VI), the Minerals Management Service (MMS), Chevron Research Corporation, Entergy, and the U.S. Navy. The GCOS modeling analysis was conducted in three phases.

The modeling analysis included base-case model application and performance evaluation, current-year modeling for 2002, and future-year modeling for 2005 (GCOS Phase II) and 2012 (GCOS Phase III). The future-year modeling included a series of emission reduction sensitivity simulations (2005), and a series of Ozone and Precursor Tagging Methodology (OPTM) simulations (2012). In addition, control-strategy simulations to examine the potential effects of the Clean Air Interstate Rule (CAIR) on ozone concentrations along the Gulf Coast were also conducted.

The modeling results and supporting data were distributed to the GCOS technical working group through an innovative database and graphical analysis tool, which was developed by ICF. The Access Database for Visualizing and Investigating Strategies for Ozone Reduction (ADVISOR), allows users to easily and quickly view (and extract) the data in spreadsheet format and create plots, the contents of which reflect various user-specified options. The ADVISOR database also supports application of draft EPA 8-hour ozone attainment procedures (including the calculation of site-specific relative reduction factors and estimated design values).

The GCOS modeling analysis also included the development and maintenance of a project web site ([gcossaintl.com](http://gcossaintl.com)), which was quite useful in disseminating information to the GCOS technical and policy committees.

The technical information from this study has provided an improved understanding of ozone issues along the eastern Gulf Coast and a basis for local and regional air quality planning through 2012. GCOS is an excellent example of a public-private partnership seeking understanding of and, ultimately, effective solutions to environmental problems. This study highlights ICF's experience in air quality modeling, air quality data analysis (including CART), emission inventory preparation (including NEI and offshore emissions), meteorological modeling (with MM5), EPA regulations and submittal procedures, and database management

## Arkansas-Tennessee-Mississippi Ozone Study (ATMOS)

**Clients:** States of Arkansas, Tennessee, and Mississippi

**Contact:** Mr. Mark McCorkle, Arkansas Department of Environmental Quality, 8001 National Drive, Little Rock, AR 72219, [MAC@adeq.state.ar.us](mailto:MAC@adeq.state.ar.us)

**Period of Performance:** January 1999 to April 2005

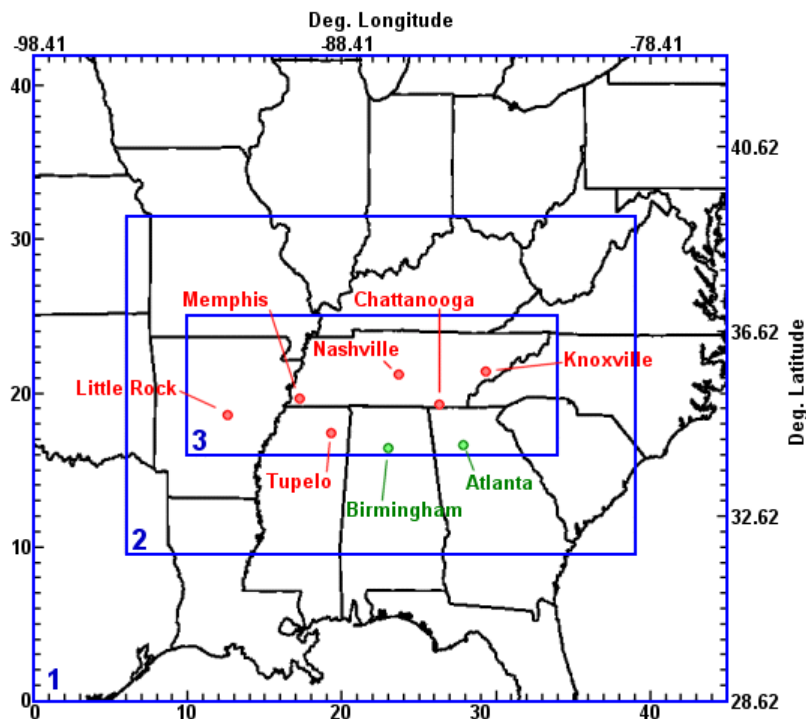
The Arkansas-Tennessee-Mississippi Ozone Study (ATMOS) modeling analysis was designed to provide technical information relevant to attainment of an 8-hour National Ambient Air Quality Standard (NAAQS) for ozone in the Memphis, Nashville, and Knoxville areas. This information was intended to provide the basis for attainment planning for each of the areas. In addition, the analysis will also provide information for addressing 8-hour ozone issues in the Hamilton County (Chattanooga), Tennessee; Lee County (Tupelo), Mississippi; and Little Rock, Arkansas areas (see figure below). The modeling analysis included an examination of the effects of the Regional

NO<sub>x</sub> SIP Call, Tier II motor vehicle and fuel standards, and additional reductions in emissions of volatile organic compound (VOC) and oxides of nitrogen (NO<sub>x</sub>).

The ATMOS study included the regional-scale application of the variable-grid Urban Airshed Model (UAM-V) for the 29 August – 9 September 1999 episode. The model application included input preparation (including dynamic meteorological modeling using MM5), base-year emission inventory preparation (using EPS2.5), model performance evaluation, future-year emission inventory preparation, and a future-year modeling exercise (for 2010).

The modeling analysis included the preparation of detailed, model-ready emission inventories for 1999 and 2010. The 1999 emission inventory was based on the latest available (1996 or later) National Emissions Trends (NET) emissions data and incorporates (as available) updated information provided by the States. This included the most recent mobile source information for the State of Tennessee and the use of MOBILE6 and EPA's latest NONROAD model. The 1999 emission inventory was projected to 2010 for the future-year (attainment) modeling. The second phase examined the level and type of additional control measures (beyond the NO<sub>x</sub> SIP Call and Tier II emission reductions) that would be required to attain the 8-hour ozone NAAQS. The project included the development of a web site ([atmos.saintl.com](http://atmos.saintl.com)) for disseminating information and the use of the ADVISOR tool for displaying and analyzing modeling results.

**Figure 5-3. UAM-V Modeling Domain for the Arkansas-Tennessee-Mississippi Ozone Study (ATMOS), with 36-, 12- and 4-km Resolution Nested Grids.**



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## 6. Pricing Schedule

This section presents the estimated costs by task for Sections III-A and III-B of the Virginia Mercury Study. Information is provided on the updated form provided as part of Addendum No. 1 of the RFP. (RFP, Section V.B.5.)

Section III A			
Task		Schedule for working on and completing task	Cost
Task 1	Point Source Review	December 2006 – March 2007	\$ 11,222.00
Task 2	Inventory Summary	January – March 2007	\$ 8,120.00
Task 3	Literature Search	December 2006 – March 2007	\$ 16,401.00
Task 4	Emissions Report	January – May 2007	\$ 11,176.00
Task 5	Data Archival	March – April 2007	\$ 1,053.00
Task 6	Quality Assurance Plan	December 2006	\$ 7,530.00
Task 7	Project Management	Ongoing	\$ 10,214.00
Task 8	Other Tasks not Assigned	N/A	\$ 0.00
Section III B			
Task 1	Conceptual Model	December 2006 – March 2007	\$ 11,328.00
Task 2	Modeling Protocol	December 2006 – January 2007	\$ 7,102.00
Task 3	Sensitivity Analysis	March – August 2007	\$ 25,631.00
Task 4	Performance Evaluation	March – August 2007	\$ 18,014.00
Task 5	Modeling Simulations	May – October 2007	\$ 73,552.00
Task 6	Modeling Report	September 2007 – January 2008	\$ 15,627.00
Task 7	Data Archival	October 2007	\$ 4,411.00
Task 8	Quality Assurance Plan	December 2006	\$ 0.00
Task 9	Project Management	Ongoing	\$ 28,152.00
Task 10	Other Tasks not Assigned	N/A	\$ 0.00
Total for Sections III A and B			\$ 249,533.00

In the following, we provide loaded hourly rate information by labor category for ICF Resources, LLC.

Classification	Hourly Rate
Executive	\$ 212.00
Senior Project Manager	\$ 190.00
Project Manager	\$ 162.00
Senior Associate	\$ 102.00
Associate	\$ 80.00
Analyst	\$ 61.00
Research Assistant	\$ 52.00

## 7. SWAM Utilization (Attachment G)

This section summarizes our planned use of Virginia registered SWAM businesses for the proposed study. ICF International will act as the prime contractor and we will utilize the services of two Virginia-based SWAM businesses as subcontractors. These include LPES, Inc., a certified Small Business Enterprise, and Thruput, a certified Woman-Owned Business Enterprise. Information regarding the utilization of these firms for the proposed work is provided in the table below. (RFP, Section V.B.6.)

### Attachment G: Participation in SWAM

#### SWAM (SMALL, WOMEN AND MINORITY-OWNED BUSINESSES) UTILIZATION PLAN

Offeror Name: ICF International      Preparer Name: Jay L. Haney      Date: 10 November 2006

Is your firm a **Small Business Enterprise** certified by the Department of Minority Business Enterprise?      Yes ☐ No ☒

If yes, certification number: \_\_\_\_\_      Certification date: \_\_\_\_\_

Is your firm a Woman-owned Business Enterprise certified by the Department of Minority Business Enterprise?      Yes ☐ No ☒

If yes, certification number: \_\_\_\_\_      Certification date: \_\_\_\_\_

Is your firm a Minority-Owned Business Enterprise certified by the Department of Minority Business Enterprise?      Yes ☐ No ☒

If yes, certification number: \_\_\_\_\_      Certification date: \_\_\_\_\_

<b>1. Plans for Utilization of SWAM Businesses</b>					
<b>SWAM Business Name &amp; Address</b>	<b>SWAM Status: Small (S), Women (W), Minority (M) &amp; DMBE Certif. # &amp; Date</b>	<b>Contact Person, Tele. &amp; Email</b>	<b>Type of Goods and/or Services</b>	<b>Planned Contract Involvement</b>	<b>Planned Annual Contract Dollar Expenditure Amount</b>
LPES, Inc. 14053 Lawnes Creek Road Smithfield, VA 23430	S, 626954 (May 17, 2005)	Timothy Lavallee 757-357-0730 tlavallee@lpesinc.com	Environmental consulting services	Assist in mercury emission inventory review task	\$ 12,320.00 (total)
Thruput 7261 Sleigh Hill Drive Saltville, VA 24370	W, 661584 (July 1, 2006)	Diane Shotynski 276-944-2378 Dian_shot@peoplepc.com	Environmental consulting services	Assist in mercury emission inventory review task	\$ 3,556.00 (total)
<b>Totals \$</b>					<b>\$ 15,876.00</b>

## 8. References

- Brieman, L., J. H. Friedman, R. A. Olshen, and C. J. Stone. 1984. *Classification and Regression Trees*. Wadsworth, Belmont, California.
- Douglas, S., B. Hudischewskyj, and T. Myers. 2003. "CART Analysis of Wet and Dry Mercury Deposition for Three Locations in Wisconsin." Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, D.C. ICF International, San Rafael, California (03-015).
- Douglas, S., T. Myers, and Y. Wei. 2006. "Implementation of Mercury Tagging in the Community Multi-scale Air Quality Model." Prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. ICF International, San Rafael, California (06-051).
- EPA. 2006. "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM<sub>2.5</sub>, and Regional Haze," Draft 3.2, EPA Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina (September 2006).
- Myers, T., Wei, B. Hudischewskyj, J. Haney, and S. Douglas. 2006. "Model-Based Analysis and Tracking of Airborne Mercury Emissions that May Contribute to Water Quality Impacts." Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, D.C. ICF International, San Rafael, California (06-077).
- Steinberg, D. and P. Colla. 1997. *CART—Classification and Regression Trees*. Salford Systems, San Diego, CA.

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## 9. Appendix: Resumes

- Jay Haney
- Sharon Douglas
- Tom Myers
- David Burch
- YiHua Wei
- Belle Hudischewskyj
- Boddu Venkatesh
- Tim Lavallee
- Diane Shotynksi
-

**Jay L. Haney****ICF International****EDUCATION**

M.S. in meteorology, Saint Louis University, 1980  
B.S. in meteorology, Saint Louis University, 1978

**PROFESSIONAL CERTIFICATION**

American Meteorological Society Certified Consulting Meteorologist (CCM No. 455)

**EXPERIENCE**

Mr. Jay L. Haney is Group Vice President and Director of the Air Quality Modeling Group at ICF International. He is a Certified Consulting Meteorologist and has an M.S. degree in meteorology from Saint Louis University. Mr. Haney has over 27 years of experience in the refinement of data analysis and modeling techniques applied to the study of tropospheric ozone, carbon monoxide, and particulate matter. In the mid-1980s, Mr. Haney was involved in some of the first practical applications of the Urban Airshed Model (UAM), including those for Philadelphia, Los Angeles, and the South Central Coast Air Basin of California. In the late 1980s, Mr. Haney was involved in a number of ozone air quality "scoping" studies that were undertaken to assess the planning needs of the area and provide recommendations/decisions for data acquisition, analysis, and modeling for those urban areas considering photochemical grid modeling for urban ozone planning purposes. Scoping studies were performed for San Diego, Sacramento, San Luis Obispo, Louisville, and the Lake Michigan area.

Mr. Haney has worked with numerous Federal, State, and local agencies in managing a number of studies involving application of the UAM or UAM-V modeling systems to ozone State Implementation Plan (SIP) development for Atlanta, Baton Rouge, Beaumont/Port Arthur, Cincinnati, Dallas/Fort Worth, Houston/Galveston, Las Vegas, Louisville, New England (Boston), Phoenix, Sacramento, and Vancouver, B.C. He has also been involved in similar applications for Baltimore/Washington, Detroit, Chicago, and Lake Charles. International applications include those for Taipei and Kaohsiung, Taiwan. Mr. Haney has also directed applications of the UAM modeling system for carbon monoxide (CO) SIP assessment for Las Vegas and Phoenix, and was recently involved in the UAM-V application for CO for Spokane.

From 1995–97, Mr. Haney supported the Southeast Modeling Center's (composed of federal, state, and industry representatives from the Southeast states) involvement in the Ozone Transport Assessment Group's (OTAG) regional modeling analysis. Mr. Haney recently served as project manager for the Gulf Coast Ozone Study (GCOS), which was conducted from 1999–2005 to examine 8-hour average ozone issues along the Gulf Coast (Baton Rouge, New Orleans, Pascagoula, Mobile, and Pensacola). He also served as project manager for the Arkansas-Tennessee-Mississippi Ozone Study (ATMOS), which investigated similar 8-hour ozone issues for Memphis, Nashville, Knoxville, Little Rock, Tupelo, and Chattanooga. He also served as project manager for the South Carolina 8-hour ozone modeling analysis, which investigated 8-hour ozone issues throughout the State of South Carolina.

Mr. Haney is currently serving as project manager for an application of CMAQ to the southeast US, using modeling databases developed as part of the VISTAS regional haze/visibility assessment. As part of this work, he also managed the implementation of the Particle and Precursor Tagging Methodology (PPTM) into CMAQ for sulfur.

**SPECIALIZED PROFESSIONAL COMPETENCE**

- Analysis of air quality and meteorological data
- Application and evaluation of photochemical air quality simulation models
- Synoptic and boundary layer meteorology

**REPRESENTATIVE RESEARCH ASSIGNMENTS AT ICF**

- Urban and regional photochemical model applications for a number of areas
- Ozone "scoping" studies for urban areas considering the use of photochemical grid models for ozone attainment planning purposes
- Three-dimensional wind field modeling

## PROFESSIONAL EXPERIENCE

- Saint Louis University—research assistant—boundary layer meteorological studies of the Indian Ocean region
- Bombay, India, 1979—participant in the International Summer Monsoon Experiment (MONEX)

## PROFESSIONAL AFFILIATIONS

- American Meteorological Society
- Air and Waste Management Association

## PUBLICATIONS

- “West Florida Ozone Study (WFOS): An Integrated Data Analysis and Modeling Study for Western Florida” (with S. Douglas and T. Myers), (submitted for publication to the Journal of the Air and Waste Management Association, January 2006)
- “A Comparison of the Performance of CMAQ, CMAQ-MADRID 1, CMAQ-MADRID 2, and REMSAD for the Southern Oxidants Study Episode in July 1999” (with others), (submitted for publication to the Journal of Geophysical Research, December 2005)
- Mesoscale meteorological and air quality impacts of increased urban albedo and vegetation (with H. Taha and S. Douglas), *Energy and Buildings*, 25:169-177 (1997)
- Performance evaluation of four grid-based dispersion models in complex terrain (with T. W. Tesche and R. E. Morris), *Atmos. Environ.*, 21(1):233-256 (1987)
- Modeling of coal characteristics (with M. A. Yocke and C. S. Burton), *J. Energy Engineering*, 12(2):127 (1986)
- Modeling ozone control strategies in Los Angeles (with T. W. Tesche, C. Seigneur, and W. R. Oliver), *J. Environ. Eng.*, 110(1) (1984)
- Kinematic and thermal structure of two surges of flow in the northern Mozambique Channel area (with G. V. Rao), *Q. J. Roy. Meteorol. Soc.*, 108(458) (1982)

## PRESENTATIONS

- “Assessment of Impacts for the Eastern Gulf Coast Using the Preliminary 2000 Gulfwide Emission Inventory”, Presented at the Information Transfer Meeting, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana (12 January 2005)
- “The Gulf Coast Ozone Study (GCOS) and Addressing 8-Hour Ozone Issues in Pensacola,” Invited Speaker. Presented to the Pensacola Ozone Group, Pensacola, Florida, 23 October (2001)
- “Overview of ATMOS (Arkansas-Tennessee-Mississippi Ozone Study,” 2001 Annual Meeting of the Southern Section of the Air & Waste Management Association, Chattanooga, Tennessee, 8-10 August (2001)
- “Modeling Ozone Formation and Transport along the Gulf Coast: An Overview of the Gulf Coast Ozone Study,” Invited Speaker. Presented to the Gulf Coast Regional Chamber Coalition, New Orleans, Louisiana, 28 September (2000)
- “Application of the UAM-VPM Ozone/Particulate Modeling System to the Lower Fraser Valley – Vancouver, British Columbia” (with Hans Deuel and Colin diCenzo). 11<sup>th</sup> Joint Conference on the Applications of Air Pollution Meteorology with the Air and Waste Management Association, Long Beach, CA (10-13 January 2000)
- “Process-Based Analysis of the Role of the Gulf Breeze in Simulating Ozone Concentrations Along the Eastern Gulf Coast” (with Sharon Douglas and Ana Alvarez), 11<sup>th</sup> Joint Conference on the Applications of Air Pollution Meteorology with the Air and Waste Management Association, Long Beach, CA (10-13 January 2000)
- “An Overview of the Gulf Coast Ozone Study (GCOS)” (with Sharon Douglas), 11<sup>th</sup> Joint Conference on the Applications of Air Pollution Meteorology with the Air and Waste Management Association, Long Beach, CA (10-13 January 2000)
- “Development of the UAM-VPM Ozone/Particulate Modeling System” (with H. P. Deuel), presented at the Seventh International Conference—Air Pollution 99, San Francisco, California (27-29 July 1999)

- "Assessment of the Effects of Grid Resolution of Urban, Regional, and Multiscale Photochemical Simulations Using the UAM-V Modeling System" (with S. G. Douglas and Z. T. Guo), Tenth Joint Conference on the Applications of Air Pollution Meteorology with the Air and Waste Management Association, Phoenix, Arizona (11-16 January 1998)
- "Regional Differences in Ozone Pollution," Invited Talk. Presented at the EPA Revised Standards for Particulate Matter and Ozone Course, sponsored by the Northwest Center for Occupational Health and Safety, University of Washington (21 November 1997)
- "Design of the UAM-VPM Modeling System for Simulating Episodic Particulate Matter Events" (with S. G. Douglas, H. P. Deuel, and G. E. Mansell), 37<sup>th</sup> Annual Pacific North West International Section Conference – Air and Waste Management Association, Vancouver, British Columbia (12-14 November 1997).
- "Implementation and Application of the Variable Grid Urban Airshed Modeling System (UAM-V) to the Lower Fraser Valley/Vancouver Area for Ozone Assessment and Planning" (with N. K. Lolk and S. G. Douglas), 5<sup>th</sup> International Conference on Atmospheric Sciences and Applications to Air Quality, Seattle, Washington (18-20 June 1996)
- "Comparison of the UAM and UAM-V Photochemical Models for Three Atlanta-Area Ozone Episodes" (with S. G. Douglas), AMS 9<sup>th</sup> Joint Conference on Air Pollution Meteorology with AWMA, Atlanta, Georgia (28 January – February 1996)
- "An Overview of the Gulf of Mexico Air Quality Study: Data Analysis and Modeling Results (with S. G. Douglas), 15<sup>th</sup> Information Transfer Meeting, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana (12-14 December 1995)
- "Use of Aircraft Data to Support Input Development and Model Evaluation of Photochemical Models" (with S. G. Douglas), presented at the AWMA Ozone Specialty Conference — Regional Photochemical Measurement and Modeling Studies, San Diego, California (8-12 November 1993)
- "From Scoping Study to Control Strategies — A Retrospective Assessment of Recent Ozone Planning Efforts for Sacramento, California" (with R. Ireson), presented at the AWMA International Conference on Tropospheric Ozone: Nonattainment and Design Values, Boston, Massachusetts (27-30 October 1992)
- "Meteorological and Photochemical Modeling of Houston, Beaumont, and Port Arthur, Texas" (with others), presented at the AWMA Ozone Specialty Conference, Atlanta, Georgia (4-7 November 1991)
- "Acquisition of Technology, Software, and Training for the Application of the Urban Airshed Model to Ozone Nonattainment Areas in Texas" (with D. Karp), presented at the AWMA Ozone Specialty Conference, Atlanta, Georgia (4-7 November 1991)
- "Application of the Urban Airshed Model in the Baton Rouge Seven-Parish Study Area" (with others), presented at the AWMA Specialty Conference, Los Angeles, California (19-22 March 1990)
- "Application of the Urban Airshed Model in the Republic of China (Taiwan)" (with E. L. Carr), presented at the AWMA Specialty Conference, Los Angeles, California (19-22 March 1990)

## SELECTED COMPANY REPORTS

- "Gulf Coast Ozone Study (GCOS) Modeling Analysis Phase III: Additional Future-Year Assessments" (with S. Douglas, Y. Wei, B. Wang, and S. Beckmann), SYSAPP-05-025, October 2005.
- "Evaluation and Intercomparison of Four Particulate Matter (PM) Models Over the Southeastern U.S." (with AER and TVA), EPRI Technical Report 1005240, December 2004.
- "The Development of PM<sub>2.5</sub> Forecasting Tools for Selected Cities in the MARAMA Region" (with S. Douglas, J. Mangahas, and A. B. Hudischewskyj), SYSAPP-04-046, prepared for MARAMA (2004).
- "A Preliminary Assessment of On-shore Air Quality Impacts for the Eastern Gulf Coast (Louisiana to Florida) Using the 2000 Gulfwide Emissions Inventory" (with S. Douglas, Y. Wei, and T. Myers), SYSAPP-04-32, prepared for the Minerals Management Service. (2004).
- "Early Action Compact Ozone Modeling Analysis for the State of Tennessee and Adjacent Areas of Arkansas and Mississippi: Addendum to the Technical Support Document" (with S. Douglas, Y. Wei, and A. Alvarez.), SYSAPP-04-012-ADD, prepared for Southeast States Air Resource Managers (SESARM) (2004)

- "Photochemical Modeling Analysis of the Little Rock Area" (with S. Douglas, Y. Wei, J. Mangahas, A. Alvarez, G. Glass, and A. B. Hudischewskyj), SYSAPP-04-035, prepared for Arkansas DEQ (2004)
- "Early Action Compact Ozone Modeling Analysis for the Shreveport-Bossier City Metropolitan Area" (with S. Douglas, Y. Wei, J. Mangahas, A. Alvarez, G. Glass, S. Hartley, and A. B. Hudischewskyj), SYSAPP-04-013, prepared for CDM (2004)
- "Early Action Compact Ozone Modeling Analysis for the State of Tennessee and Adjacent Areas of Arkansas and Mississippi" (with S. Douglas, Y. Wei, J. Mangahas, A. Alvarez, G. Glass, S. Hartley, and A. B. Hudischewskyj), SYSAPP-04-012, prepared for Southeast States Air Resource Managers (SESARM) (2004)
- "1-Hour Ozone Attainment Demonstration Modeling for Baton Rouge for Re-Classification to Severe: Technical Support Document Addendum" (with S. Douglas, Y. Wei, A. Alvarez, and G. Glass), Report 03-061, prepared for the Louisiana Department of Environmental Quality (2004)
- "Conceptual Description of 8-Hour Ozone in the Pensacola Area and Along the Florida Panhandle" (with S. Douglas, J. Mangahas, Y. Wei, and A. B. Hudischewskyj), SYSAPP-04-003, prepared for Florida Department of Environmental Protection (2004)
- "West Florida Ozone Study (WFOS) Data Analysis and Modeling Study" (with A. B. Hudischewskyj, S. Douglas, Y. Wei, A. Alvarez, S. Hartley, G. Glass and J. Mangahas), SYSAPP-03-020, prepared for Florida Department of Environmental Protection (2004)
- "Lake Charles Ozone Modeling Analysis and Transport Assessment" (with S. Douglas, Y. Wei, A. Alvarez, G. Glass, S. Hartley, and A. B. Hudischewskyj), SYSAPP-03-053, prepared for the Louisiana Department of Environmental Quality (2003).
- "Application of the UAM-V Modeling System for the Analysis of an 8-Hour Ozone Episode for South Carolina" (with S. Douglas, Y. H. Wei, A. B. Hudischewskyj, A. Alvarez, and J. Mangahas), Report 02-114, prepared for the South Carolina Department of Health and Environmental Control (2002)
- "Ozone Episode Selection Analysis for Pensacola, Florida (1996-2001)" (with J. Mangahas, S. Douglas, A. B. Hudischewskyj, and G. Glass), Report 02-090, prepared for the Florida Department of Environmental Protection (2002)
- "CO Dispersion Model Feasibility Study: Fairbanks and Anchorage, Alaska" (with S. Douglas, M. Saeger, Y. H. Wei, A. B. Hudischewskyj, G. Glass, and R. Beizaie), Report 02-044, prepared for the State of Alaska Department of Environmental Conservation (2002)
- "Technical Support Document: 1-Hour Ozone Attainment Demonstration Modeling for Baton Rouge" (with others), Report 01-066, prepared for the Louisiana Department of Environmental Quality (2001)
- "Gulf Coast Ozone Study (GCOS) Modeling Analysis: Phase II: Methods and Results" (with S. Douglas, Y. H. Wei, A. B. Hudischewskyj, A. Alvarez, and R. Beizaie), Report 01-049, prepared for the GCOS Operations Committee (2001)
- "The Gulf of Mexico Air Quality Study: Volume I. Summary of Data Analysis and Modeling" (with others), SYSAPP-95/013d, prepared for the Minerals Management Service, (1995)
- "Demonstration Application of UAM-V for the Lower Fraser Valley" (with others), SYSAPP-95/075d, prepared for the Atmospheric Environment Service – Environment Canada (1995)
- "Application of UAM and UAM-V for the New England Ozone Nonattainment Area" (with others), SYSAPP-96/08, prepared for U.S. EPA Region I (1995)

## EMPLOYMENT HISTORY

ICF International	Group Vice President	1998–present
	Director, Urban and Regional Modeling and Planning Department	1994–1998
	Manager, Urban Modeling Applications Group	1989–1994
	Senior Scientist	1985–1989
	Staff Scientist	1980–1985
Saint Louis University	Research Assistant	1979

**Sharon G. Douglas****ICF International****EDUCATION**

B.A., Earth and Planetary Science, Johns Hopkins University, 1983  
M.S., Meteorology, Pennsylvania State University, 1986

**EXPERIENCE**

Ms. Sharon G. Douglas, Project Manager in Atmospheric Sciences for ICF International, has 19 years of experience in meteorological and air quality data analysis and modeling. At SAI/ICF, Ms. Douglas has been principally involved in the development and application of meteorological and air quality modeling tools. She has served as principal investigator for more than thirty-five projects involving the combined application of meteorological models and urban- and regional-scale air quality models for regulatory assessment and planning purposes. Areas of specialization with respect to air quality modeling include meteorological input preparation, model performance evaluation, attainment demonstration analysis, and interpretation of modeling results. Ms. Douglas has also served as principal investigator for numerous data analysis studies focused on understanding the relationships between meteorology and air quality, episode selection, and ozone and particulate matter forecasting. Ms. Douglas has successfully managed more than forty-five projects involving the analysis of air quality and meteorological data, development and application of data analysis and modeling tools, and technology transfer and training.

**PROJECT EXPERIENCE****Development, Application, and Evaluation of Meteorological Models**

Development of the SAI Mesoscale Model. Ms. Douglas implemented both dynamic initialization and four-dimensional data assimilation into the SAI Mesoscale Model, a prognostic meteorological model designed to numerically simulate the response of the atmosphere to differential heating of the earth's surface and terrain/geographical effects. This model has been used to prepare meteorological inputs for numerous urban and regional-scale applications of the UAM photochemical modeling system (applications include Los Angeles; the eastern U.S.; the Texas/Louisiana Gulf Coast; Vancouver, British Columbia; and the United Kingdom).

Development of the Diagnostic Wind Model. Ms. Douglas was co-developer of the Diagnostic Wind Model (DWM), a U.S. EPA recommended tool for preparation of wind fields for regulatory applications of the Urban Airshed Model (UAM). Ms. Douglas has also applied this model to numerous geographical areas including the Los Angeles area; the San Francisco Bay Area; Cincinnati, Ohio; and Phoenix, Arizona.

Application of the MM5 Meteorological Modeling System. Ms. Douglas recently directed several regional-scale, multiple-nested-grid applications of the Pennsylvania State University/National Center for Atmospheric Modeling (PSU/NCAR) Mesoscale Model (MM5). These applications focused on the Atlanta and Birmingham areas; the eastern Gulf Coast area; Baton Rouge, Louisiana; multiple urban areas within Tennessee; and multiple urban areas in South Carolina. Graphical and statistical analysis techniques were used to evaluate the meteorological modeling results; the MM5-derived meteorological fields were subsequently used as input for application of the variable-grid Urban Airshed Model (UAM-V) to this region.

**Application and Evaluation of Air Quality Models.**

Comparison of the UAM and UAM-V Modeling Systems for Application to the Atlanta Ozone Nonattainment Area. Ms. Douglas served as principal investigator for the application, evaluation, and comparison of the UAM and UAM-V photochemical models for three Atlanta-area ozone episodes. The results of this model comparison study were used by the Georgia Department of Natural Resources to obtain approval from the U.S. EPA to use the more advanced modeling tool (UAM-V) to conduct their State Implementation Plan (SIP) modeling.

Application of the UAM-V Modeling System to the Eastern U.S. for the Modeling Ozone Cooperative (MOCA) and the Ozone Transport Assessment Group (OTAG). Ms. Douglas served as the SAI/ICF project manager for the regional-scale application of the UAM-V modeling system to the eastern U.S. for the Modeling Ozone Cooperative (MOCA) – a public/private partnership involving the U.S. EPA, states, and industry. The UAM-V was shown to perform better than EPA's Regional Oxidant Model (ROM) in replicating a historical ozone episode and was subsequently selected for use by the Ozone Transport Assessment Group (OTAG). Ms. Douglas actively participated in numerous aspects of the OTAG modeling analysis including episode selection, model performance evaluation, and control-strategy assessment. She was an active member of the OTAG modeling team and earned a certificate of appreciation for her participation in this regional-scale modeling effort.

Prospective Analysis of the Cost and Benefits of the Clean Air Act Amendments. Ms. Douglas was the SAI/ICF project manager for a regional-scale modeling and cost/benefit analysis designed to quantify the effects of the Clean Air Act Amendments (CAA) on air quality, public health, and the economy. The study entails regional-scale modeling of the entire U.S. (contiguous 48 states) and focuses on ozone, particulate matter (PM), and other criteria pollutants. The model outputs provide the basis for estimates of future air quality and physical effects and economic valuation modeling.

Analysis of the Air-Quality Related Social Costs of On-Highway Transportation. Ms. Douglas is currently the project manager for the fourth in a series of projects involving the development and application of air quality modeling tools and techniques for the estimation of the air quality related social costs of motor vehicles. This has included the application of regional-scale photochemical and particulate models and the development of a screening technique for estimating the air quality impacts of increases and decreases in vehicle miles traveled (VMT) for different types of vehicles.

Analysis of the Effects of Urban Heat Island Mitigation Measures on Ozone Air Quality. Ms. Douglas recently served as the technical lead on a photochemical modeling-based analysis of the effects of Heat Island Reduction Initiative (HIRI) measures on ozone concentrations in urban areas. The measures include use of reflective roofing and paving materials and tree planting. The potential ozone air quality benefits of implemented these measures is being evaluated using regional-scale meteorological and photochemical modeling.

Estimation of Modeling System Noise for Two Applications of the UAM-V Modeling System. Ms. Douglas was co-manager and a key participant in a study designed to quantify modeling system uncertainty. The uncertainty analysis involved modification of modeling system inputs within known accuracy limits, and assessment of the effects of the modifications on model output and response. The results of this study have been used to aid the interpretation and comparison of control strategy modeling results for OTAG and the Atlanta ozone nonattainment area.

Gulf Coast Ozone Study. Ms. Douglas is currently serving as co-manager and principal investigator for Phase III of the Gulf Coast Ozone Study (GCOS). This regional-scale meteorological and photochemical modeling study was designed to obtain a better understanding of the causes and sources of high observed ozone concentrations along the eastern Gulf Coast of the U.S. and to estimate the types and amounts of emission reductions that will be required for future compliance with the proposed 8-hour ozone standard. The modeling and analysis study focuses on the eastern Gulf Coast, with emphasis on potential 8-hour ozone nonattainment areas in Florida, Alabama, Mississippi, and Louisiana. Phase III of this study uses the Ozone and Precursor Tagging Method to examine the sources and source regions that are contributing to 8-hour ozone along the Gulf Coast.

Baton Rouge SIP Modeling Analysis. Ms. Douglas was recently co-manager for a modeling project to support the development of the State Implementation Plan for 1-hour ozone for Baton Rouge, Louisiana. The modeling analysis has included a comprehensive episode-selection analysis (to identify suitable periods for modeling), application of the UAM-V photochemical modeling system for three multi-day simulation periods, evaluation of model performance, use of the modeling system to estimate ozone concentrations for a future-year of 2005, analysis of the effects of various emissions reduction scenarios on future-year ozone air quality, evaluation of specific ozone attainment strategies, and application of EPA attainment demonstration procedures. The application of the attainment demonstration procedures considered both the procedures put forth by EPA in 1996 for 1-hour ozone attainment demonstration as well as those included as part of the newer EPA guidance on the use of models for demonstrating attainment of the 8-hour (and 1-hour) ozone standard(s). The technical support documentation was approved by EPA.

REMSAD Modeling to Support Multi-Pollutant Legislation. Ms. Douglas recently served as project manager for the application of the Regional Modeling System for Aerosols and Deposition (REMSAD) for the continental U.S. to evaluate the effects of changes in emissions on particulate matter (PM) and mercury (airborne concentrations and deposition). The modeling system was being applied for a 1-year simulation period.

South Carolina 8-Hour Ozone Modeling Study. Ms. Douglas recently served as co-manager and principal investigator for the South Carolina 8-hour ozone modeling analysis. The project included the development of a base- and future-year regional-scale emissions inventories, the regional application of meteorological and photochemical modeling tools to simulate a multi-day historical ozone episode, future-year modeling, transfer of the photochemical modeling tools and databases to the state, and training for South Carolina Department of Health and Environmental Control (SC DHEC) staff in the use of our modeling tools. Good model performance was achieved for the areas of interest throughout the state. The future-year modeling results indicate attainment or near attainment for all South Carolina sites by 2010. The databases prepared as part of this analysis were used to support the development of an Early Action Compact (EAC) for several areas in South Carolina.

Arkansas-Tennessee-Mississippi Ozone Study (ATMOS). Ms. Douglas is currently serving as co-manager and principal investigator for the ATMOS 8-hour ozone modeling analysis. The project elements include a detailed episode selection analysis, development of a modeling protocol, development of a base- and future-year regional-scale emissions inventories, regional application of meteorological and photochemical modeling tools to simulate a multi-day historical ozone episode, future-year modeling, and control strategy evaluation. Good model performance was achieved for the areas of interest throughout the state. Emission sensitivity simulations were conducted to support the evaluation of regional and local control measures. The databases prepared as part of this analysis were used to support the development of an Early Action Compact (EAC) for several areas in Tennessee, Mississippi, and Arkansas. Currently the project is focused on the continued analysis of attainment strategies and refining the conceptual description for 8-hour ozone for the Memphis, Knoxville, and Chattanooga areas.

West Florida Ozone Study. Ms. Douglas recently served as co-manager and principal investigator for the West Florida Ozone Study (WFOS). This regional-scale meteorological and photochemical modeling study was a follow-on to Phase II of GCOS and was designed to obtain a better understanding of the causes and sources of high observed ozone concentrations within the Pensacola area and along the eastern Gulf Coast. The results of this study were used to support future air quality planning for Pensacola and other areas within the Florida panhandle, and to estimate the types and amounts of emission reductions that will be required for future compliance with the new 8-hour ozone standard.

### **Meteorological and Air Quality Data Analysis**

Development of an Episode Selection Methodology. Ms. Douglas has served as project manager for several recent projects involving the development and application of objective procedures for episode selection. The methodology involves application of the Classification and Regression Tree (CART) statistical analysis technique to facilitate the identification of modeling "episode" periods that are representative of the meteorological and air quality conditions that characterize an area's air quality problem.

This technique has been used to guide the selection of episodes for the integrated modeling of ozone, PM (visibility), and acid deposition (for the Southern Appalachian Mountains Initiative) as well as regional-scale modeling related to the new U.S. EPA 8-hour National Ambient Air Quality Standard (NAAQS) (for the States of Alabama, Florida, Georgia, Louisiana, Mississippi, Tennessee, and Arkansas).

Ms. Douglas is currently serving as project manager for an episode selection analysis related to 1-hour and 8-hour ozone for several areas in Northern Georgia and Northern Alabama, including Atlanta, Macon, and Columbus. The objective of this study is to identify representative modeling episode periods for future photochemical modeling of these areas to support air quality planning and SIP development.

Development of a Statistical-Based Ozone and PM<sub>2.5</sub> Forecasting Tools. Ms. Douglas has led and continues to lead numerous recent studies involving the development of a statistical-based ozone and PM<sub>2.5</sub> forecasting tools. The forecasting algorithms are based on application of the CART statistical analysis technique. Interactive forecasting tools have been developed for both ozone (for Little Rock, Memphis, coastal areas in Mississippi and Florida) and PM<sub>2.5</sub> (for ten areas in the Northeastern U.S.). SAI's tools are currently being used in preparing daily ozone and PM<sub>2.5</sub> forecasts for these areas.

Analysis of Wind Profiler and RASS Data. Ms. Douglas recently served as project manager for an evaluation of wind profiler and RASS acoustic sounding meteorological data collected during the 1992 Southern California Air Quality Study. The quality and utility of the data were evaluated through comparison with data collected using routine meteorological monitoring techniques and through graphical and statistical analysis techniques. In addition, Ms. Douglas was also the SAI/ICF manager for a work assignment involving update of EPA guidance for the collection and quality assurance of upper-air meteorological data.

SEARCH Data Analysis. Ms. Douglas is currently the project manager for a data analysis project involving the use of SouthEastern Aerosols Research and CHaracterization Study (SEARCH) data to explore the relationships between aerosol formation, composition, and transport and meteorology. These findings will be used to guide the development of recommendations for selecting discrete modeling episode periods for air quality modeling applications, with consideration of the frequency and magnitude of measured PM<sub>2.5</sub> events, observed variations in the relative importance of the PM constituents, the type and range of important PM-related processes, the geographical scales encompassed by both urban-health and regional-haze issues, and potential interactions with ozone and other pollutants. The emphasis of the analysis is PM<sub>2.5</sub> and regional haze. The episode selection procedures will also be used to construct a set of episode days for regional-scale modeling of the Southeast that will provide the basis for a meaningful model application and attainment demonstration for PM<sub>2.5</sub> and visibility.

VISTAS Meteorological Characterization Analysis. Ms. Douglas is currently the project manager for a data analysis project involving the use of Classification and Regression Tree (CART) statistical analysis to classify days for the period 2000–2002 according to visibility (as defined by the extinction coefficient) and meteorological parameters. The CART results are being used to develop a conceptual description for visibility in the VISTAS region, on a site-specific and regional basis. The CART results will be used to define the role of meteorology in determining visibility and distinguishing between hazy and clear days for each site. A key element in this project is the development of an interactive analytical tool that, in its characterization mode, allows users to extract information and answer questions about how well selected days or groups of days represent the visibility (and optionally PM<sub>2.5</sub>) and meteorological characteristics for a selected site or group of sites. In an alternative, episode selection mode, the analytical tool also provide lists of days and multi-day periods that best achieve episode selection criteria which are defined based on user-specified input parameters.

### Technology Transfer and Training

SAIMM Transfer and Training. Ms. Douglas has led the transfer of the SAIMM meteorological modeling system to several agencies and organizations including the South Coast Air Quality Management District (SCAQMD), the Texas Natural Resources Conservation Commission (TNRCC), and Honda. She has also directed and participated in training workshops for each transfer of the modeling system.

UAM-V Transfer and Training. Ms. Douglas has been involved in the transfer of the UAM-V photochemical modeling system to more than a dozen agencies and organizations including two of the OTAG modeling centers, the U.S. EPA, National Power Company (U.K.), and EniTecnologie (Italy). She has also participated in six multi-day training workshops related to the UAM-V modeling system.

## SELECTED PUBLICATIONS AND PRESENTATIONS

### Publications

- "A Comparison of the Performance of CMAQ, CMAQ-MADRID 1, CMAQ-MADRID 2, and REMSAD for the Southern Oxidants Study Episode in July 1999" (with others), (submitted for publication to the Journal of Geophysical Research, December 2005)
- Mesoscale meteorological and air quality impacts of increased urban albedo and vegetation (with H. Taha and J. Haney), *Energy and Buildings*, 25:169-177 (1997)
- Analysis of mesoscale airflow patterns in the South-Central Coast Air Basin during the SCCAMP-1985 intensive measurement periods (with R. Kessler), *J. Appl. Meteorol.*, 30(5):607-631 (May 1991)
- A numerical study of mesoscale eddy development over the Santa Barbara Channel (with R. Kessler), *J. Appl. Meteorol.*, 30(5):633-651 (May 1991)
- Utilization of VAS satellite data in the initialization of an oceanic-cyclogenesis simulation (with T. T. Warner), *Mon. Wea. Rev.*, 115:2996-3012 (December 1987)

### Presentations

- "Episode Selection Analysis for PM and Visibility Using the 1999/2000 SEARCH Database" Invited Speaker, VISTAS Technical Workshop, Research Triangle Park, North Carolina, 16 October (2002)
- "Experience in PM<sub>2.5</sub> Modeling of the Southeastern U.S." Invited Speaker. Presented to the VISTAS Technical Workgroup, Research Triangle Park, North Carolina, 16 October (2002)
- "Monitoring Data to Support VISTAS Regional Air Quality Modeling," Invited Speaker, VISTAS Data Workshop, Atlanta, Georgia, 14 January (2002)
- "The Gulf Coast Ozone Study (GCOS) and Addressing 8-Hour Ozone Issues in Pensacola," Invited Speaker, Presented to the Pensacola Ozone Group, Pensacola, Florida, 23 October (2001)
- "Overview of ATMOS (Arkansas-Tennessee-Mississippi Ozone Study)," 2001 Annual Meeting of the Southern Section of the Air & Waste Management Association, Chattanooga, Tennessee, 8-10 August (2001)
- "Modeling Ozone Formation and Transport along the Gulf Coast: An Overview of the Gulf Coast Ozone Study," Invited Speaker, Presented to the Gulf Coast Regional Chamber Coalition, New Orleans, Louisiana, 28 September (2000)

- "Use of the UAM-V Modeling System as an Air Quality Planning Tool and for Examining Heat Island Reduction Strategies" (with A. B. Hudischewskyj and V. Gorsevski), ACEEE 2000 Summer Study on Energy Efficiency in Buildings, Pacific Grove, California (2000)
- "Photochemical Smog Modeling," Invited Speaker, International Workshop on Particulate Matter Issues In Air Quality Management, Asian Institute of Technology, Bangkok, Thailand, 22-24 March (2000)
- "Photochemical Smog Modeling," Invited Speaker, University of Rome, La Sapienza, Rome, Italy, 18 May (2000)
- "Development of an Objective Approach to Episode Selection to Air Quality Modeling" (with H. P. Deuel and A. B. Hudischewskyj), AMS/AWMA 11<sup>th</sup> Joint Conference on Air Pollution Meteorology, Long Beach, California (1999)
- "Development of a Homology Mapping Technique for Estimating Ozone Concentrations in Unmonitored Areas" (with R. K. Iwamiya and H. P. Deuel), AMS/AWMA 11<sup>th</sup> Joint Conference on Air Pollution Meteorology, Long Beach, California (1999)
- "Process-Based Analysis of the Role of the Gulf Breeze in Simulating Ozone Concentrations Along the Eastern Gulf Coast" (with A. R. Alvarez and J. L. Haney), AMS/AWMA 11<sup>th</sup> Joint Conference on Air Pollution Meteorology, Long Beach, California (1999)
- "Use of the UAM-V Process Analysis and Source Attribution Features to Assess Model Performance and Response for Urban- and Regional-Scale Applications" (with H. P. Deuel and J. L. Haney), AMS/AWMA 10<sup>th</sup> Joint Conference on the Applications of Air Pollution Meteorology, Phoenix, Arizona (1998)
- "Comparison of the UAM and UAM-V Photochemical Models for Three Atlanta-Area Ozone Episodes" (with J. L. Haney), AMS 9<sup>th</sup> Joint Conference on Air Pollution Meteorology with AWMA, Atlanta, Georgia (1996)
- "An Overview of the Gulf of Mexico Air Quality Study: Data Analysis and Modeling Results (with J. L. Haney), 15<sup>th</sup> Information Transfer Meeting, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana (1995)
- "Meteorological Modeling to Support Urban and Regional Photochemical Modeling of Los Angeles, Sacramento, and the Texas/ Louisiana Gulf Coast" (with N. K. Lolk and S. Mitsutomi), AWMA International Conference on Regional Photochemical Measurement and Modeling Studies, San Diego, California (1993)
- "Preparation of Meteorological Fields for Air Quality Modeling Using Mesoscale Data Assimilation" (with R. C. Kessler and J. Lester), AWMA Specialty Conference on Tropospheric Ozone and the Environment II, Atlanta, Georgia (1991)
- "Meteorological and Photochemical Modeling of Houston, Beaumont, and Port Arthur, Texas" (with J. L. Haney and D. Karp), AWMA Specialty Conference on Tropospheric Ozone and the Environment II, Atlanta, Georgia (1991)
- "Objective Combination of Prognostic-Model Wind Fields and Observational Data for the San Joaquin Valley" (with R. Kessler), AWMA Specialty Conference on Tropospheric Ozone and the Environment (20-22 March 1990)
- "Identification and Tracking of Polluted Air Masses in the South Central Coast Air Basin" (with others), AWMA Specialty Conference on Tropospheric Ozone and the Environment (20-22 March 1990)
- "Assessment of the Proposed Upper-Air Monitoring Network for the San Joaquin Valley Air Quality Study Using Observing System Simulation Experiments" (with R. Kessler), AMS Seventh Joint Conference on Applications of Air Pollution Meteorology with AWMA (14-18 January 1991)
- "Use of a Mesoscale Meteorological Model to Generate Meteorological Inputs for Photochemical Simulation of a High-Ozone Episode in the San Joaquin Valley" (with others), AMS Seventh Joint Conference on Applications of Air Pollution Meteorology with AWMA (14-18 January 1991)
- "Urban Airshed Modeling for a Seven Parish Baton Rouge Area Study" (with others), AWMA Specialty Conference on Tropospheric Ozone and the Environment (20-22 March 1990)

#### Selected Company Reports

- "Application of the UAM-V Modeling System for the Analysis of an 8-Hour Ozone Episode for South Carolina" (with Y. H. Wei, A. B. Hudischewskyj, A. Alvarez, J. Mangahas, and J. Haney), Report 02-114, prepared for the South Carolina Department of Health and Environmental Control (2002)
- "Ozone Episode Selection Analysis for Pensacola, Florida (1996-2001)" (with J. Mangahas, A. B. Hudischewskyj, G. Glass, and J. Haney), Report 02-090, prepared for the Florida Department of Environmental Protection (2002)

- "Ozone Episode Selection Analysis for Urban Areas in Northern Georgia and Northern Alabama (1995-2001)" (with A. B. Hudischewskyj, G. Glass, and A. Alvarez), Report 02-049, prepared for Southern Company (2002)
- "CO Dispersion Model Feasibility Study: Fairbanks and Anchorage, Alaska" (with M. Saeger, J. Haney, Y. H. Wei, A. B. Hudischewskyj, G. Glass, and R. Beizaie), Report 02-044, prepared for the State of Alaska Department of Environmental Conservation (2002)
- "1-Hour Ozone Attainment Demonstration Modeling for Baton Rouge" (with Y. H. Wei, A. Alvarez, A. B. Hudischewskyj, R. Beizaie, and J. L. Haney), SYSAPP-01-066, prepared for the Louisiana Department of Environmental Quality (2001).
- "Gulf Coast Ozone Study (GCOS) Modeling Analysis: Phase II Methods and Results" (with Y. H. Wei, A. B. Hudischewskyj, A. Alvarez, R. Beizaie, and J. L. Haney), SYSAPP-01-049, prepared for the States of Florida, Alabama, Mississippi, and Louisiana and Southern Company (2001).
- "Vehicle Miles Traveled and the Social Costs of Air Pollution" (with A. Alvarez, R. Beizaie, G. Glass, K. Davidson, and D. McCubbin), SYSAPP-01-090, prepared for U.S. Environmental Protection Agency, Office of Transportation & Air Quality (2001).
- "Improving Relationships Between Highway Travel By Different Vehicle Classes, Emissions, And Social Costs Of Air Pollution" (with A. Alvarez and R. Beizaie), Technical Memorandum, prepared for the Federal Highways Administration (2000).
- "Input Preparation Methodologies for Application of the UAM-V to the Western U.S.," Technical Memorandum, prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards (1999).
- "Summary of Future-Year Simulations for the Birmingham Area Using the 7-15 July 1995 Episode", Technical Memorandum, SYSAPP-99/14, Prepared for the Alabama Department of Environmental Management (1999).
- "Subregional Photochemical Modeling Analysis for Atlanta, Birmingham, and the Eastern Gulf Coast Area: Input Preparation and Model Performance Evaluation" (with H. H. Tunggal, G. E. Mansell, and J. L. Haney), SYSAPP-98/43, prepared for the Southern Company (1998)
- "A Statistical Forecasting Model for Ozone in the Region des Bouches du Rhone" (with H. P. Deuel and A. B. Hudischewskyj), SYSAPP-98/29, prepared for AIRFOBEP (Martigues, France) (1998)
- "Estimation of Modeling System Noise for Two Applications of the UAM-V Modeling System: One-Hour Ozone, Eight-Hour Ozone, and Ozone Exposure (with H. P. Deuel and C. S. Burton), SYSAPP-98/27, prepared for the Utilities Air Regulatory Group (1998)
- "The Combined Use of Observational Data and Air Quality Modeling Results to Estimate Future-Year Ozone Concentrations: Overview of the Methodology" (with R. K. Iwamiya), SYSAPP-98/26, prepared for Abt Associates, Inc. (1998)
- "Episode Selection for the Integrated Analysis of Ozone, Visibility, and Acid Deposition for the Southern Appalachian Mountains" (with H. P. Deuel), SYSAPP-98/07r1, prepared for the Southern Appalachian Mountains Initiative (1998)
- "Air-Pollution-Related Social Costs of On-Highway Transportation Sources, Part I: Air Quality Modeling" (with others), SYSAPP-98/14r1, prepared for the U.S. EPA Office of Policy, Planning, and Evaluation (1998)
- "Demonstration Application of the UAM-V Modeling System for the United Kingdom" (with others), SYSAPP-98/13, prepared for National Power PLC (Swindon, England) (1998)
- "Prospective Analysis of Air Quality in the U.S.: Air Quality Modeling" (with others), SYSAPP-97/69, prepared for the U.S. EPA, Office of Policy Analysis and Review (1998)
- "Ozone and Particulate Matter Air Quality Scoping Study for the Pacific Northwest" (with Jay L. Haney and B. E. Koenig), SYSAPP-97/51, prepared for the Washington Department of Ecology and the U.S. EPA, Region X (1998)
- "Analysis of Southern California Wind Profiler and Aircraft Data" (with others), SYSAPP-97-95/91r3, prepared for the California Air Resources Board (1997)
- "NAAQS Analysis Support Task 1: Episode Selection" (with A. B. Hudischewskyj), SYSAPP-97/55, prepared for U.S. EPA Office of Air Quality Planning and Standards (1997)
- "NAAQS Analysis Support Task 2: Model Performance" (with A. B. Hudischewskyj and S. T. Malkin), SYSAPP-97/53, prepared for the U.S. EPA Office of Air Quality Planning and Standards (1997)

- "An Investigation of UAM-IV Model Performance Using the Process Analysis/Integrated Reaction Rate Technique for Two Multi-Day Episodes for Southeast Texas" (with H. P. Deuel and J. L. Haney), SYSAPP-97/52, prepared for the Texas Natural Resource Conservation Commission (1997)
- "NAAQS Analysis Support Task 3: Early Assessment" (with A. B. Hudischewskyj and S. T. Malkin), SYSAPP-97/42, prepared for the U.S. EPA Office of Air Quality Planning and Standards (1997)
- "Examination of the UAM-V Simulation Process in the Lake Michigan Area for Selected OTAG Baseline and Control Strategy Simulations" (with H. P. Deuel), SYSAPP-97/37, prepared for the Illinois Environmental Protection Agency (1997)
- "UAM Modeling Analysis of the Louisville Multistate Moderate Ozone Nonattainment Area" (with others), SYSAPP-97/35, prepared for Jefferson County Air Pollution Control District (1997)
- "Identification of Candidate Modeling Episodes for the Birmingham Area Considering both a One-Hour and an Eight-Hour Ozone Standard" (with A. B. Hudischewskyj), SYSAPP-97/24, prepared for Southern Company Services, Inc. (1997)
- "Identification of Candidate Modeling Episodes for the Atlanta Ozone Nonattainment Area Considering both a One-Hour and an Eight-Hour Ozone Standard" (with A. B. Hudischewskyj), SYSAPP-97/21, prepared for Southern Company Services, Inc. (1997)
- "Examination of the Effects of Lake Michigan Area NO<sub>x</sub> Control on Ozone Air Quality in the Lake Michigan Area and the Northeast Ozone Transport Region" (with others), SYSAPP-97/20, prepared for the Lake Michigan Utilities Group (1997)
- "UAM-V Environmental Impact Analysis of the Effects of Simulated Emissions Changes from 1988 to 2007 on Ozone Air Quality in the Eastern U.S." (with H. P. Deuel), SYSAPP-97/12, prepared for the U.S. EPA, Office of Air Quality Planning and Standards (1997)
- "Classification of Ozone Episodes for Four Southern Cities According to Transport Characteristics" (with A. B. Hudischewskyj), SYSAPP-97/03, prepared for Southern Company Services, Inc. (1997)
- "Preparation of UAM-V Ready Meteorological Input Files for the Eastern United States for 1-15 July 1988" (with N. K. Lolk and Z. Guo), SYSAPP-97/25r, prepared for the U.S. EPA Office of Air Quality Planning and Standards (1996)
- "Application of the SAIMM for the Lower Fraser Valley for 1-6 August 1993" (with Z. Guo and N. K. Lolk), SYSAPP-96/82, prepared for the Atmospheric Environment Service of Environment Canada (1996)
- "Comparison of MOCA Coarse-Grid and Full Nested-Grid UAM-V Simulated Ozone Concentrations for 4-11 July 1988" (with A. B. Hudischewskyj), SYSAPP-96/77, prepared for Southern Company Services, Inc. (1996)
- "Investigation of the Effects of Horizontal Grid Resolution on UAM-V Simulation Results for Three Urban Areas" (with N. K. Lolk and J. L. Haney), SYSAPP-96/65, prepared for Southern Company Services, Inc. (1996)
- "UAM-V Simulations in Support of the Base-Case Modeling Analysis for the 1-15 July OTAG Episode" (with N. K. Lolk and H. P. Deuel), SYSAPP-96/52, prepared for the U. S. EPA Office of Air Quality Planning and Standards (1996)
- "Evaluation of Meteorological Inputs to UAM-V for Four OTAG Modeling Episodes" (with N. K. Lolk and Z. T. Guo), SYSAPP-96/45, prepared for the Southeast Modeling Center (1996)
- "Application of UAM and UAM-V for the New England Ozone Nonattainment Area" (with others), SYSAPP-96/08, prepared for U.S. EPA, Region I (1995)
- "Classification and Regression Tree Analysis to Support the Selection of Episodes for Regional-Scale Photochemical Modeling of the Southeastern U.S." (with H. P. Deuel and J. L. Haney), SYSAPP-95/084d, prepared for Southern Company Services, Inc. (1995)
- "Application of the Urban Airshed Model to Baton Rouge, Louisiana for Three Additional Multi-Day Ozone Episodes. Volume III: Diagnostic/Sensitivity Analysis and Model Performance Evaluation" (with A. B. Hudischewskyj and J. L. Haney), SYSAPP-95/079, prepared for Louisiana Department of Environmental Quality (1995)
- "Application of the Urban Airshed Model to Baton Rouge, Louisiana for Three Additional Multi-Day Ozone Episodes. Volume I: UAM Input Preparation" (with A. B. Hudischewskyj and J. L. Haney), SYSAPP-95/077, prepared for Louisiana Department of Environmental Quality (1995)
- "Demonstration Application of UAM-V for the Lower Fraser Valley" (with others), SYSAPP-95/075d, prepared for Atmospheric Environment Service, Environment Canada (1995)

- "Application of the Urban Airshed Model to the Baton Rouge, Louisiana Ozone Nonattainment Area" (with others), SYSAPP-95/071, prepared for Louisiana Department of Environmental Quality (1995)
- "UAM Modeling Analysis of the Cincinnati-Hamilton Multistate Moderate Ozone Nonattainment Area" (with others), SYSAPP-95/059, prepared for Pacific Environmental Services, Inc. and U.S. Environmental Protection Agency (1995)
- "Application of UAM-V for the Houston/Galveston and Beaumont/Port Arthur Nonattainment Areas for Two Multi-day Ozone Episodes. Volume I: UAM Input Preparation" (with others), SYSAPP-95/054, prepared for Texas Natural Resource Conservation Commission (1995)
- "Application of UAM-V for the Houston/Galveston and Beaumont/Port Arthur Nonattainment Areas for Two Multi-day Ozone Episodes. Volume II: UAM-V Model Performance Evaluation" (with others), SYSAPP-95/067, prepared for Texas Natural Resources Conservation Commission (1995)
- "Application of UAM-V to the Northeast as Part of Phase I of the Modeling Ozone Cooperative (MOCA)" (with others), SYSAPP-95/049d, prepared for the MOCA Technical Committee, Edison Electric Institute (1995)
- "Preparation of UAM-Ready Mixing-Height Fields for Five Northeastern U.S. UAM Modeling Domains for the July 1988 Ozone Episode" (with N. K. Lolk), SYSAPP-95/020, prepared for MOCA Technical Committee, Edison Electric Institute (1995)
- "Comparison of 1988 EPS 2.0 MOCA Inventory with 1988 FREDS Inventory" (with others), SYSAPP-95/016, prepared for MOCA Technical Committee, Edison Electric Institute (1995)
- "Preparation of Alternative Mixing-Height Fields for UAM Modeling of the 27-31 July 1987 St. Louis Ozone Episode" (with N. K. Lolk), SYSAPP-95/014, prepared for Missouri Department of Natural Resources (1995)
- "Comparison of the UAM-IV and UAM-V Photochemical Models for Three Atlanta-Area Ozone Episodes" (with others), SYSAPP-94/106, prepared for Atlanta UAM-IV/UAM-V Comparison Technical Work Group, Georgia Environmental Protection Division, EPA Region IV, Southern Company Services, Georgia Power Company, and Georgia Institute of Technology (1994)
- "Photochemical Modeling of the Lake Charles Ozone Nonattainment Area: UAM Sensitivity Analysis" (with others), SYSAPP-94/084, prepared for Lake Charles Ozone Task Force and Louisiana Department of Environmental Quality (1994)
- "Application of the Urban Airshed Model to Baton Rouge, Louisiana for Three Multi-Day Ozone Episodes. Volume I: UAM Input Preparation" (with J. L. Haney), SYSAPP-94/095, prepared for Louisiana Department of Environmental Quality (1994)
- "Application of the Urban Airshed Model to Baton Rouge, Louisiana for Three Multi-Day Ozone Episodes. Technical Support Document" (with J. L. Haney), SYSAPP-94/096, prepared for Louisiana Department of Environmental Quality (1994)
- "Application of the Urban Airshed Model to Baton Rouge, Louisiana for Three Multi-Day Ozone Episodes. Volume III: Diagnostic/Sensitivity Analysis and Model Performance Evaluation" (with J. L. Haney), SYSAPP-94/090, prepared for Louisiana Department of Environmental Quality (1994)
- "Photochemical Modeling of the Louisville Ozone Nonattainment Area. Volume I: UAM Input Preparation" (with others), SYSAPP-94/046d, prepared for Jefferson County Air Pollution Control District (1994)
- "Preparation of Alternative Mixing-Height and Wind Fields for UAM Modeling of the 19-21 July 1987 North Carolina Ozone Episode" (with A. B. Hudischewskyj), SYSAPP-94/042, prepared for Duke Power Company, Environmental Engineering Generation Services Department (1994)
- "Photochemical Modeling of the Maricopa County Ozone Nonattainment Area" (with others), SYSAPP-93/195, prepared for Maricopa Association of Governments (1993)
- "Photochemical Modeling of the Broader Sacramento Area: Base-Case Modeling Analysis" (with S. B. Shepard and J. L. Haney), SYSAPP-93/056, prepared for California Air Resources Board (1993)
- "Wind Field Model Development and Enhancement" (with N. K. Lolk), SYSAPP-93/053, prepared for South Coast Air Quality Management District (1993)
- "Sacramento FIP Modeling 5: Diagnostic and Initial Target Simulations" (with S. B. Shepard and J. L. Haney), SYSAPP-93/038, prepared for U.S. Environmental Protection Agency (1993)

- "UAM Modeling Analysis of the Cincinnati-Hamilton Multi-State Moderate Ozone Nonattainment Area: UAM Input Preparation" (with others), SYSAPP-93/028, prepared for Pacific Environmental Services, Inc. and U. S. Environmental Protection Agency (1993)
- "UAM Modeling Analysis of the Huntington-Ashland Multi-State Moderate Ozone Nonattainment Area: UAM Input Preparation" (with others), SYSAPP-93/027, prepared for Pacific Environmental Services, Inc. and U.S. Environmental Protection Agency (1993)
- "Photochemical Modeling for the Southeast Michigan Ozone Study (SEMOS)" (with others), SYSAPP-93/013, prepared for Southeast Michigan Council of Governments (1993)
- "Sacramento FIP Modeling 1: Assessment of Pollutant Transport" (with N. K. Lolk and A. B. Hudischewskyj), prepared for U.S. Environmental Protection Agency (1993)
- "Protocol for Photochemical Modeling of the Huntington-Ashland Ozone Nonattainment Area" (with others), SYSAPP-92/114, prepared for U.S. Environmental Protection Agency (1992)
- "Protocol for Photochemical Modeling of the Cincinnati-Hamilton Ozone Nonattainment Area" (with others), SYSAPP-92/113, prepared for U.S. Environmental Protection Agency (1992)
- "User's Guide to the Systems Applications International Mesoscale Model (Version 1.0)" (with R. C. Kessler), SYSAPP-92/069 (1992)
- "Photochemical Modeling for the Four Areas in Texas, Volume II: UAM Application for Houston, Beaumont, and Port Arthur" (with others), SYSAPP-93/120b, prepared for the Texas Air Control Board (1991)
- "Diagnostic Analysis of Wind Observations Collected During the Southern California Air Quality Study" (with others), SYSAPP-91/079, prepared for California Air Resources Board (1991)
- "Photochemical Modeling Study for Southeastern Michigan" (with others), SYSAPP-91/018, prepared for Michigan Department of Natural Resources (1991)
- "Evaluation of PARIS Performance in the South Central Coast Air Basin" (with others), SYSAPP-90/122, prepared for U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region (1990)
- "Impacts of Changes in Precursor Emissions from the San Francisco Bay Area on Ozone in the North Central Coast and San Joaquin Valley Air Basins" (with others), SYSAPP-90/142, prepared for California Air Resources Board (1990)
- "Modeling the Impacts of Future Offshore Petroleum Development on Air Quality in Central Coast Counties" (with others), SYSAPP-90/035, prepared for Bay Area Air Quality Management District (1990)
- "Ozone Air Quality Scoping Study for the Lower Lake Michigan Air Quality Region" (with others), SYSAPP-89/113, prepared for U.S. Environmental Protection Agency (1989)
- "Ozone Scoping Study for Jefferson County--Louisville, Kentucky" (with others), SYSAPP-89/118, prepared for Jefferson County Air Pollution Control District (1989)
- "Numerical Simulation of Mesoscale Airflow in the South Central Coast Air Basin" (with R. Kessler), SYSAPP-89/108, prepared for Sigma Research Corporation (1989)
- "Benefits and Consequences of Adopting Intermittent Controls as a Strategy for the San Francisco Bay Area" (with others), prepared for Western States Petroleum Association (1989)
- "Numerical Simulation of Summer Mesoscale Airflow in the Central Valley of California" (with R. Kessler), prepared for San Joaquin Valley Air Pollution Study Agency (1989)
- "Objective Combination of Prognostic Model Wind Fields and Observational Data for the San Joaquin Valley" (1989)
- "Assessment of the Proposed Upper-Air Monitoring Network for the San Joaquin Valley Air Quality Study Through Observing System Simulation Experiments" (with R. Kessler), prepared for San Joaquin Valley Air Pollution Study Agency (1989)
- "User's Guide to the UAM Wind Preprocessor System" (with others), SYSAPP-89/079, prepared for U.S. Environmental Protection Agency (1989)

- "User's Guide to the Diagnostic Wind Model (Version 1.0)" (with R. Kessler) (1988)
- "Analysis of Wind Fields for the SCCCAMP 1985 Intensive Measurement Periods" (with R. Kessler), SYSAPP-87/215, prepared for Sigma Research Corporation (1987)

### PROFESSIONAL MEMBERSHIP

Air and Waste Management Association  
American Meteorological Society  
Phi Beta Kappa

### EMPLOYMENT HISTORY

SAI/ICF International	Project Manager	1995–present
SAI/ICF Consulting	Senior Scientist	1989–1995
Systems Applications International (SAI)	Staff Scientist	1987–1989
Pennsylvania State University	Research Assistant	1983–1986
	Teaching Assistant	Spring 1986
National Meteorological Center	Research Aide	Summer 1982, 1983

**Thomas C. Myers****ICF International****EDUCATION**

M.A. in physics, University of California at Davis, 1976  
B.S. in physics, University of the Pacific, 1971

**EXPERIENCE**

Mr. Myers, Project Manager, Urban and Regional Modeling, has over 28 years of experience in air quality model application and development. His principal areas of experience are in the application and development of photochemical air quality models, but he also has experience with many different modeling tools. Mr. Myers has managed a number of modeling applications using UAM-IV, UAM-V, and REMSAD among other models.

Mr. Myers is the principal developer of the Variable grid Urban Airshed Model (UAM-V) and has managed a number of applications of UAM-V for domains in the U.S. and abroad. Mr. Myers also has experience with applications of a number of other models including UAM-IV. He has managed projects applying UAM-IV in urban domains in various parts of the U.S. He has participated in several projects to evaluate the potential impacts of emissions from individual sources on pollutant levels in urban areas. Mr. Myers also has experience in the use of gaussian models such as ISCST and MSDM. During his tenure at ICF, Mr. Myers has participated in virtually every aspect of urban scale modeling, from preparation of emissions and meteorological data, to model development, to analysis of model results.

Mr. Myers has led recent improvements to the Region Modeling System for Aerosols and Deposition (REMSAD). REMSAD is typically applied at continental scale to evaluate particulate matter concentrations, long-range transport of acid species such as sulfate and nitrate, and air deposition of toxics such as dioxin, cadmium and mercury.

Mr. Myers joined ICF International after receiving an M.A. in physics from the University of California at Davis. As an undergraduate, he engaged in research on the evolution of planetary atmospheres, and as a graduate student he was involved in research in elementary particle physics.

**PROJECT EXPERIENCE****Air Quality Modeling of Toxics and Other Species and Model Development**

Analysis of Mercury Air Sources That May Contribute To Water Quality Impacts. Mr. Myers is currently managing an analysis of mercury air sources that may be contributing to mercury impairments and fish consumption advisories nationwide. ICF International is performing this analysis for EPA OW. The results will serve as a basis for regions and states to determine reductions in air loadings needed to meet mercury water quality and fish tissue criteria. ICF International will conduct analyses using the Regional Modeling System for Aerosols and Deposition (REMSAD) model to identify the major sources of mercury deposition within each state. The model has a feature that can be used to identify the deposition from specific categories of air sources. Over 300 categories and locations will be tracked during the simulations to allow attribution of deposition to the originating sources and locations.

Atmospheric Deposition Modeling of Mercury, Nitrogen, and Other Pollutants to Support Water Quality Analyses, EPA OW. Mr. Myers managed a project for the EPA OW to apply the REMSAD modeling system to the coterminous U.S. in order to evaluate the contributions to nitrogen deposition of emissions from each of the lower 48 states. This application used the tagging system developed under Mr. Myers's direction in earlier projects. The tagging feature allows deposition amounts to be attributed to separate original sources of the pollutant mass. In this project Mr. Myers added the capability of tagging for dioxin and lead in the REMSAD model which will allow estimates to be made of the contribution of various emissions sources to deposition of these compounds. Continental scale REMSAD applications were made of mercury deposition using two different meteorological databases.

Mercury Air Deposition TMDL Development for Maryland, EPA Region 3. Mr. Myers managed a project to provide support to EPA Region 3 in developing a TMDL for deposition of mercury in Maryland. Mr. Myers supervised the application of the REMSAD model to the coterminous U.S. simulating transport and deposition of mercury. Use of the tagging feature of REMSAD, which allows the contributions of various source to be quantified, provided estimates of the separate contributions to deposition of mercury from several categories of emissions in Maryland, surrounding states, the remainder of the U.S., Canada, and background. Mr. Myers also transferred the modeling system to EPA Region 3 and provided training for Region 3 staff on the application of the model.

REMSAD Air Deposition Modeling for Southern Louisiana, EPA Region 6. Mr. Myers managed a project to provide support to EPA Region 6 in estimating contributions to deposition of mercury in the Gulf Coastal basins of southern Louisiana. Mr. Myers supervised the application of the REMSAD model to the coterminous U.S. simulating transport and deposition of mercury. Use of the tagging feature of REMSAD, which allows the contributions of various source to be quantified, provided estimates of the separate contributions to deposition of mercury from several categories of emissions in Louisiana, the remainder of the U.S., Canada, and background. Simulated deposition estimates were converted to GIS data files and transferred to EPA Region 6 for their use in developing TMDLs for the Gulf Coastal basins.

Testing, evaluation, and maintenance of the REMSAD modeling system, EPA OAQPS. Mr. Myers managed a project for the EPA OAQPS to test and evaluate the REMSAD modeling system. In this project, a number of features of the model have been improved and tested including: making use of more of the data available from metrological models typically used to provide inputs to the air quality models; upgrading the gas phase chemical mechanism to more accurately treat the chemistry at high altitudes and low temperatures; evaluating and improving the wet deposition algorithm in the model; and expanding the treatment of the formation of sulfate in aqueous phase. Under this project, Mr. Myers has also provided support to other users of the REMSAD model including states and RPOs.

Nitrogen and Mercury Deposition Modeling in the U.S., EPA. Mr. Myers managed a project for EPA Office of Water to apply the REMSAD modeling system to the continental U.S. to evaluate nitrogen and mercury deposition to watersheds. Meteorological input data was developed from the Rapid Update Cycle (RUC) data obtained from NCAR. Many improvements to the REMSAD system were implemented during this project, including an expanded chemical mechanism for mercury and incorporation of the MARS-A algorithm for aqueous phase nitrate partitioning. In addition, simulations of deposition of cadmium were made utilizing a tagging method that allows deposition to be attributed to the original source of the cadmium emissions.

Implementation of Nitrogen tagging system in the REMSAD model, EPA. Mr. Myers managed a project to develop and apply a nitrogen tagging system in the REMSAD model. This complex development tracks separately the emissions of nitrogen from different sources. The gas phase chemical mechanism was expanded to handle multiple NO<sub>x</sub> species associated with each of several emissions sources. In this current project, for instance, it was possible to differentiate at any given time and location nitrogen in the form of nitrate or ammonia originating from mobile sources from that originating from stationary sources. Likewise deposition can be differentiated by source type.

Photochemical Modeling in the Sacramento Area, Sierra Research. Mr. Myers managed a project to assess the effects of changes in NO<sub>x</sub> and VOC emissions on the ozone levels in the Sacramento area. The results of the simulations were used to assist the Sacramento Municipal Utility District (SMUD) in developing inter-pollutant trading ratios.

Photochemical Modeling of the Northeastern U.S., Honda R&D. Mr. Myers managed a project to simulate the Northeastern U.S. with the UAM-V modeling system. During this project, the chemical mechanism was updated to include the CB-IV-TOX mechanism, which provides a more detailed treatment of aldehydes and toxic species than the standard CB-IV mechanism. Input data files were prepared at 4-km resolution using the SAIMM and the EPA's NET 96 emissions inventory. Results were compared to existing simulations performed as part of the OTAG study.

Evaluation of an Ozone Scavenging Catalyst, Engelhard Corp. Mr. Myers has managed projects involving UAM applications to regions in Southern California. The applications included modifications to emissions inputs and sensitivity to changes in other input data. He managed projects to evaluate innovative ozone control strategies involving an ozone destroying catalyst and compared the effects to traditional emissions control approaches.

Modeling of Effects on Air Quality of Alternative Fuels, NREL. Mr. Myers co-managed a project for NREL to model the potential effects of alternative fuels on air quality in several U.S. cities. Estimates were made of the effects of conversion of motor vehicle fleets in Los Angeles to CNG or methanol fuels. Effects of variations in heavy-duty vehicle emissions on air quality were also modeled.

LMOS Modeling of Lake Michigan Area, LADCO. Since Mr. Myers was a key participant in the development of the UAM-V, the nested grid version of the UAM, he was an important team member in the application of the UAM-V to the Lake Michigan area. This application will ultimately be used by the states in the area to develop SIPs.

Gulf of Mexico Air Quality Study, MMS. Mr. Myers' skills were utilized in the application of UAM-V to the Gulf of Mexico region for MMS. This project evaluated the potential impacts of offshore oil development on air quality in the coastal areas of Texas and Louisiana.

Modeling of Eastern U.S., MOCA. Mr. Myers incorporated a number of extensions into the UAM-V for the application of UAM-V in the northeastern U.S. for the MOCA project.

SAQM Plume-in-Grid Module, CARB. Mr. Myers managed a project to install a Plume-in-Grid treatment in the SARMAP Air Quality Model (SAQM) for the California Air Resources Board.

OTAG Modeling, EPA, others. Mr. Myers participated in modeling efforts of the Northeastern U.S. based on the OTAG modeling system that investigated effects of specific emission controls. Mr. Myers provided training sessions on the application of UAM-V to many of the OTAG participants.

International Modeling Projects. Over the years, Mr. Myers has been involved in several international projects using the UAM system. He has applied UAM-IV, the predecessor of UAM-V, for the simulation of urban smog in Athens and Mexico City, and he recently completed the application and testing of the UAM-V for Lyon, France. At the conclusion of this project, Mr. Myers installed the model, related software, and data files for this simulation at four automobile and oil industry research facilities in France, and conducted training sessions in the use of the model and interpretation of results. He has also provided modeling assistance and training for researchers in the United Kingdom, Japan, and at the European Commission Joint Research Center in Italy.

Evaluation of SCAQMD AQMP, City of Los Angeles. Mr. Myers assisted in the modeling of the South Coast Air Basin for the City of Los Angeles to evaluate potential alternative strategies to the SCAQMD's Air Quality Management Plan for ozone.

Demonstration of PLANR procedures for UAM modeling, EPA. Mr. Myers' experience with the UAM made him an important participant in the development of the PLANR methods for application of the UAM. He assisted in setting up the applications of the PLANR methods to Dallas, Philadelphia, New York, Atlanta, and St. Louis. This demonstration of straightforward application procedures ultimately led to the routine use of UAM for SIP planning purposes.

## Database Development

Plume Model Validation Study, EPRI. Mr. Myers was involved in designing and using the EPRI PMV databases to exercise and evaluate various plume models. He also assisted in maintenance of the EPRI PMV data archival system and has used the SIR database language for data archiving.

Eastern Lakes Survey-II, EPA-LV. Mr. Myers supervised the data entry procedures in the ELS-II project and processed the data into database files using dBase III+ and the SAS system. He has experience in database development on both mainframe and microcomputer systems.

## SELECTED PUBLICATIONS AND PRESENTATIONS

- "Evaluation of the Nested-Grid Urban Airshed Model (UAM-V) Using the Extensive Lake Michigan Ozone Study (LMOS) Field Study Data Base," paper presented at the annual meeting of the Air and Waste Management Association (June 19-24, 1994)
- "Procedures for Developing Boundary Conditions and Sensitivity of Simulating Ozone Formation in Lake Michigan to the Definition of Boundary Conditions," paper submitted in response to invitation for Session M6 - Course Scale Modeling to Develop Regional Modeling Inputs, Regional Photochemical Air Quality Measurement and Modeling Studies, San Diego, CA (November 7-12, 1993)
- "Application and Evaluation of the Nested-Grid Urban Airshed Model (UAM-V) in the Lake Michigan Ozone Study (LMOS)," paper proposed for presentation at Session M5 - Photochemical Modeling, Regional Photochemical Air Quality Measurement and Modeling Studies, San Diego, CA (November 7-12, 1993)
- "Design of the UAM-V Integrated Photochemical Modeling System - Discussion of Model Components and Adaptation of the System to the Lake Michigan, Gulf Coast, and Northeast U.S. Regions," paper proposed for presentation at Session M1 - Design of Integrated Modeling Systems, Regional Photochemical Air Quality Measurement and Modeling Studies, San Diego, CA (November 7-12, 1993)
- "Performance Evaluation of the "Super-Fast" Versions of UAM-IV and UAM-V," paper proposed for presentation at Session M5 - Photochemical Modeling, Regional Photochemical Air Quality Measurement and Modeling Studies, International Specialty Conference, San Diego, CA (November 7-12, 1993)

- "Photochemical Modeling of the Lake Michigan Region Using the Nested-Grid Urban Airshed Model," presented at the 86th Annual Meeting of the Air and Waste Management Association, Denver, CO (June 14-18, 1993)
- "Overview of the Variable-Grid Urban Airshed Model (UAM-V)," presented at the 85th Annual Meeting of the Air and Waste Management Association, Kansas City, MO (June 21-26, 1992)
- "Use of Dynamic Meteorological Models as Input to Photochemical Dispersion Models" (with T. W. Tesche and G. E. Moore), presented at the annual meeting of the Air Pollution Control Association, Minneapolis, Minnesota (1986)
- Mathematical model for the analysis of wind-turbine wakes (with M. K. Liu and M. A. Yocke), J. Energy, 7:73 (1983)
- Numerical modeling of land and sea breeze circulation along a complex coastline (with M. K. Liu and J. L. McElroy), Mathematics and Computers in Simulation, 21:359-367 (1979)
- "Mathematical Simulation of Land-Sea Breezes" (with M. K. Liu and J. L. McElroy), Proc. Summer Computer Simulation Conference, Newport Beach, California, (1978)

#### Selected Company Reports

- "Mercury Air Deposition TMDL Development for Maryland (Draft Report)" (with Y. Wei, B. Hudischewskyj, and S. Douglas) ICF Consulting (04-068), prepared for EPA Region 3.
- "REMSAD Air Deposition Modeling in Support of TMDL Development for Southern Louisiana" (with Y. Wei) ICF Consulting (04-038), prepared for EPA Region 6.
- "Updated REMSAD Modeling for Estimation of the Deposition of Mercury in Support of the Wisconsin TMDL Pilot (Draft Report)" (with Y. Wei and B. Hudischewskyj) ICF Consulting (2005), prepared for EPA OW.
- "Application of a Nitrogen Attribution Method to Deposition Estimates for the Lower 48 States (In preparation)" (with Y. Wei) ICF Consulting (2005), for EPA OW.
- "Application of the REMSAD Modeling System to Estimate the Deposition of Mercury in Support of the Wisconsin TMDL Pilot," (with Y.H. Wei, B. Hudischewskyj, and S. Douglas) Systems Applications International/ICF Consulting (03-050), prepared for EPA OW.
- "Development and Application of a Nitrogen Attribution Method in the Regional Modeling System for Aerosols and Deposition (REMSAD)," (with G. Z. Whitten and Y. H. Wei) Systems Applications International/ICF Consulting (03-042), prepared for EPA OW.
- "Application of the REMSAD Modeling System to Estimate the Deposition of Nitrogen and Mercury (Draft Report)" (with Y. Wei, G. Glass, J. Mangahas, B. Hudischewskyj) ICF Consulting (02-101), prepared for EPA OW.
- "Ozone Sensitivity Simulations in the Sacramento Area to Evaluate Inter-pollutant Emissions Trading," ICF Consulting/SAI 02-017, prepared for Sierra Research.
- "Development of High-Resolution Modeling Databases for the Northeastern U.S. and Application of the UAM-V to the Northeastern U.S.," SYSAPP-2005, prepared for Honda R&D, Ltd.
- "The Effects of Application of the PremAir™ Catalyst on Ozone Levels in Urban Areas," SYSAPP-99/19r1, prepared for Engelhard Corp.
- "Estimation of the Effects of an Ozone Control Strategy Focusing on Air Conditioning-Bound Catalysts for Ozone Scrubbing (Draft)" (with others), SYSAPP97/59, prepared for the South Coast Air Quality Management District (1997)
- "Methodology for Developing Emissions Inventories and Air Quality Modeling in the Auto/Oil Program, Phase II" (with others), SYSAPP96/31, prepared for the Auto/Oil Air Quality Improvement Research Program (1997)
- "The Implementation of a Plume-in-Grid Module in the SARMAP Air Quality Model (SAQM)" (with others), SYSAPP96/06, prepared for the San Joaquin Valleywide Air Pollution Study Agency (1996)
- "Photochemical Modeling of the Lake Michigan Region for the 1991 Lake Michigan Ozone Study (LMOS) Episodes Using the Nested-Grid Urban Airshed Model (UAM-V)" (with others), SYSAPP94-93/174, prepared for the Lake Michigan Air Directors Consortium (1994)

- "Preliminary Photochemical Modeling of the Lake Michigan Region Using the Nested-Grid Urban Airshed Model (UAM-V)" (with others), prepared for Lake Michigan Air Directors Consortium (1992)
- "Technical Achievements and Progress on SCE Technical Services Purchase Orders C1030011, C0130010, and C1030915" (with others), prepared for Southern California Edison Company (1991)
- "Evaluation of PARIS Performance in the South Central Coast Air Basin" (with others), SYSAPP-90/122, prepared for U.S. Department of the Interior, Minerals Management Service (1990)
- "Modeling of the South Central Coast Air Basin with the Carbon-Bond IV Version of the Urban Airshed Model," SYSAPP-90/117, prepared for U.S. Environmental Protection Agency (1990)
- "Revised Modeling of Air Quality Impacts from the Harry Allen Station" (with M. A. Yocke), SYSAPP-90/069, prepared for Nevada Power Company (1990)
- "Urban Airshed Model Studies of Five Cities: Low-Cost Application of the Model to Future-Year SIP Control and Alternative Fuel Strategies for Dallas-Fort Worth, Atlanta, Philadelphia, and St. Louis. Volume I: Results" (with others), SYSAPP-90/027a, prepared for U.S. Environmental Protection Agency (1990)
- "Urban Airshed Model Studies of Five Cities: Low-Cost Application of the Model to Future-Year SIP Control and Alternative Fuel Strategies for Dallas-Fort Worth, Atlanta, Philadelphia, and St. Louis. Volume II: App. B-II" (with others), SYSAPP-90/027b, prepared for U.S. Environmental Protection Agency (1990)
- "Urban Airshed Model Study of Five Cities: Demonstration of Low-Cost Application of the Model to the City of Atlanta and the Dallas-Fort Worth Metroplex Region" (with others), SYSAPP-90/022, prepared for U.S. Environmental Protection Agency (1990)
- "Urban Airshed Model Study of Five Cities: Evaluation of Base Case Model Performance for the Cities of St. Louis and Philadelphia Using Rich and Sparse Meteorological Inputs" (with others), SYSAPP-90/024, prepared for U.S. Environmental Protection Agency (1990)
- "Urban Airshed Model Study of Five Cities: Low-Cost Application of the Model to Atlanta and Evaluation of the Effects of Biogenic Emissions on Emission Control Strategies" (with others), SYSAPP-90/026, prepared for U.S. Environmental Protection Agency (1990)

## EMPLOYMENT HISTORY

ICF International	Project Manager	1998–present
ICF Kaiser	Senior Associate	1993–1998
Systems Applications International	Senior Scientist	1985–1993
	Staff Scientist	1977–1985
University of California, Davis Department of Physics	Reader/Teaching Assistant	1975–1976

**David Burch**  
**Project Manager****ICF Consulting****EDUCATION**

M.E.M. (Master of Environmental Management), Environmental Chemistry and Toxicology, Nicholas School of the Environment, Duke University, Durham, North Carolina, 1997  
B.S., Chemistry, Duke University, Durham, North Carolina, 1993

**EXPERIENCE OVERVIEW**

Mr. Burch is a Project Manager in ICF Consulting's Environmental Science and Engineering Practice with 11 years of professional experience in risk assessment, fate and transport modeling, environmental and organic chemistry, and related areas. He is currently serving as Deputy Program Manager for ICF's technical risk assessment mission support contract with EPA's Office of Air Quality Planning and Standards (OAQPS) and has a lead role in several tasks involving technical support of residual risk assessments, EPA's TRIM.FaTE multimedia fate and transport model, and other risk assessment and environmental chemistry projects. Managerial responsibilities involve supervising and tracking financial and staffing aspects of ongoing tasks, day-to-day coordination with OAQPS technical staff regarding ICF's support, and working with EPA task managers to ensure client satisfaction. Over the last eight years, Mr. Burch has provided ongoing technical support to OAQPS' residual risk program, primarily by directing and carrying out human health and ecological risk assessments for various source categories as a part of EPA's residual risk assessment program. In addition, he has contributed to the technical writing, editing, and final document production for several major OAQPS documents, including the Residual Risk Report to Congress and the Mercury Study Report to Congress, and numerous technical contractor reports. For Department of Defense clients, Mr. Burch has performed human health and ecological risk assessments of Air Force and Navy facilities in accordance with RCRA guidelines. Mr. Burch has also provided technical and administrative support for a major industry trade group and other private industry clients. Prior to his experience in the environmental field, Mr. Burch was a synthetic organic chemist for two years and is familiar with chemical synthesis, separation, and analytical techniques for organic and inorganic compounds.

**PROJECT EXPERIENCE****Risk and Exposure Assessment**

Residual (Post-MACT) Risk Assessments, EPA/OAQPS, 1998 to present. Mr. Burch is currently the ICF work assignment manager (WAM) for ICF's work assignment with OAQPS to provide technical risk assessment capabilities in support of EPA's analysis of risks associated with post-MACT emissions (i.e., residual risks), as specified in CAA section 112(f). As the ICF WAM for this and similar previous residual risk-related work assignments, Mr. Burch is responsible for keeping EPA clients apprised of project activities and progress through formal monthly reports and frequent informal communications, tracking expenses, managing staffing for specific tasks, and providing technical review of analysis results and documentation completed for various source category risk assessments completed under these work assignments. Technical project duties include data acquisition (including characterization of emissions and sources, defining the physical/chemical attributes of emitted substances, and obtaining dose-response data on the pollutants of concern), exposure modeling of emissions (e.g., application of screening-level and refined air dispersion models), analysis of the potential for multimedia and indirect exposures, and risk characterization. See also paragraphs below for details regarding source category-specific projects.

Lead NAAQS Exposure and Risk Assessment, EPA/OAQPS, 2005-Present. As a part of ICF's support to EPA for the exposure and risk assessments performed as part of the review of the lead NAAQS, Mr. Burch has assisted in developing the analytical framework and assessment methodology and the approach to fate and transport modeling. Using data from the scientific literature and model results, he is estimating lead exposures for a pilot phase scenario that will be used to model the incremental blood-lead levels resulting from exposure to lead in soils adjacent to and on roadways. In a related effort, Mr. Burch is coordinating the development of a revised algorithm and parameter library for EPA's TRIM.FaTE model to enable the fate and transport modeling of lead through air, soil, surface water, and groundwater. It is expected that this model will be used in upcoming analyses for the lead NAAQS.

Risk and Technology Review II, EPA/OAQPS, 2006 to present. Mr. Burch is directing ICF's technical support in the development of a Risk and Technology Review (RTR) rule for about 50 industrial source categories, characterized as the RTR II group. Under RTR II, EPA is evaluating residual (i.e., post-MACT) emissions of HAPs for multiple source categories in order to conduct a comprehensive residual risk assessment across all categories focusing on inhalation exposures. The results of the assessment will be used to develop a rule for these categories that addresses EPA's regulatory responsibilities for residual risk as specified

under section 112(f) of the Clean Air Act. Categories for which there is a likelihood of non-inhalation risks (e.g., via ingestion exposures to chemicals that deposit to soil and water and accumulate in the food chain) will be screened out of the RTR II group and subjected to further analysis. ICF is working closely with a team of EPA engineers and scientists as well as other EPA contractor support staff to collect source category-specific data from EPA's 2002 National Emissions Inventory (NEI), review these data for accuracy and implement updates and edits as necessary, and compile the air dispersion modeling inputs. ICF is also providing technical input on the modeling approach and overall risk assessment methodology, performing quality assurance on model results, assisting with risk characterization and presentation of results, and documenting methodology of the assessment, including writing regulatory text for the rule. To efficiently provide support under tight deadlines for this high-profile effort, Mr. Burch is coordinating a team of ICF junior and senior staff in performing data base queries, conducting analyses, and writing text while also maintaining close contact with various EPA staff and other contractors participating in the project. Results of the current evaluations are being made public by EPA through an Advanced Notice of Public Rulemaking (ANPR), with a proposed RTR rule expected sometime in 2007.

Residual Risk Assessment, Gasoline Distribution (Stage I) Source Category, EPA/OAQPS, 1999 to present. Mr. Burch has managed ICF's recent support of EPA's residual risk assessment efforts for the final decision for this source category. Specific aspects of the analysis included implementation of data queries on EPA's National Emissions Inventory (NEI) database, analysis of facility-specific data and parameters for the potential universe of 1400+ facilities within this source category, chronic and acute exposure and risk modeling using EPA's HEM-Screen and SCREEN3 air dispersion and exposure models, documentation of the assessment methodology, data inputs, and results, and responding to workgroup and other internal technical reviewers of the risk assessment methodology and results. For this project, Mr. Burch managed junior ICF staff and directed subcontractor staff to accomplish the technical project goals within budget under a tight schedule and assisted EPA in meeting their deadlines in support of the final residual risk decision for this source category. Risk assessment results were used by EPA to inform the development of the final residual risk decision for this source category (see 71 FR 17352, April 2006), and ICF's technical documentation is included in the docket as the scientific basis for the decision. From 1999 to 2000, Mr. Burch also contributed to additional screening-level exposure and risk assessments on a subset of facilities in this source category.

Residual Risk Assessment, Wood Furniture Manufacturing Source Category, EPA/OAQPS, 2003 to 2004. Mr. Burch was responsible for coordinating ICF's support of residual risk assessment for several hundred major sources in this source category. Technical tasks have included designing an appropriate methodology for a screening-level assessment for this category, implementing queries of EPA's NEI database to retrieve source category information for modeling, modeling chronic and acute inhalation exposures and risks using EPA's Human Exposure Model (a screening-level air dispersion and risk calculation model) and the SCREEN3 dispersion model, and documentation of risk assessment activities in support of a decision for the "residual risk test" (i.e., screening-level assessment decision point) for this source category.

Residual Risk Assessment, Chromium Electroplating Source Category, EPA/OAQPS, 1998 to 2000; 2004 to 2005. For the chromium electroplating/anodizing source category, Mr. Burch was responsible for the selection, development, and implementation of an appropriate screening method for assessing multimedia exposures of hazardous air pollutants (HAPs) and the ecological risks associated with these exposures. Mr. Burch developed screening-level estimates of risks to indicator organisms for several key facilities within the source category universe. In support of EPA's more recent work for this category, Mr. Burch developed a methodology to evaluate the total incremental cancer risk associated with chromium emissions from 29 electroplating facilities clustered in the Chicago area to determine if co-location is an issue for the category. The approach for this evaluation involved developing facility parameters based on plant survey data, configuring model input files for application of the ISCST3 dispersion model, and collecting relevant population data to predict maximum individual cancer risks and population risks (e.g., number of people exposed, estimated number of excess cancer cases/year). Model runs were initiated but put on hold due to changing EPA priorities in 2005.

TRIM.FaTE Fate and Transport Model: Model Development, Testing, and Application, EPA/OAQPS, 1999 to present. Mr. Burch has a lead role in ICF's ongoing technical assistance to EPA for the development of TRIM.FaTE, the fate and transport and ecological exposure module of the Total Risk Integrated Methodology (TRIM). This multimedia model is designed to track pollutants emitted into the air as they partition into biotic and abiotic media and are affected by natural environmental processes (e.g., chemical and biotic degradation and transformation). ICF has worked closely with EPA and other researchers to apply the appropriate algorithms, implement the algorithms within the modeling framework, operate and troubleshoot the model, and interpret results of model tests. Specific tasks during the development phase of the TRIM.FaTE model have included an analysis of the effect of the spatial layout of model compartments on predicted air concentrations, a comparison of TRIM.FaTE predicted air concentrations with those predicted by EPA's ISCST3 and UAM models, and a comparison of TRIM.FaTE test case results to

multimedia results generated by EPA's Indirect Exposure Methodology (IEM). Additional details for related projects are described separately in the summaries below. Results of these tasks have been incorporated into TRIM.FaTE documentation, including TRIM status reports and a formal report presented to the Science Advisory Board.

TRIM.FaTE Mercury Test Case, EPA/OAQPS, 1999 to 2005. For work related to the development, testing, and analysis of EPA's TRIM.FaTE model, Mr. Burch has been involved in an application of the TRIM.FaTE model to assess mercury emissions from a chloralkali facility. Tasks have included a general review of predicted media concentrations for the test case, consideration of temporal and spatial concentration patterns, comparison of modeled concentrations to measured environmental data, analysis of the predicted mercury speciation for abiotic and biotic compartments included in the test case, the application of uncertainty and sensitivity tools included in TRIM.FaTE, and the interpretation of sensitivity analysis results for the test case site. Mr. Burch has been involved in various aspects of all of these tasks and is contributing to the final documentation for this test case by writing technical sections and providing technical review for the entire evaluation report. Previously, in conjunction with earlier analysis of the TRIM.FaTE mercury test case, Mr. Burch conducted a multi-pathway exposure assessment of mercury emissions for the chloralkali facility for comparison to TRIM.FaTE results. Mercury exposures for key scenarios were calculated using IEM-2M, the EPA multimedia exposure model developed to calculate human exposures to mercury for the 1997 Mercury Study Report to Congress, and additional analyses were completed to estimate spatial and temporal variation in exposures and to obtain a screening-level estimate of population exposure.

Application of TRIM.FaTE for Two Secondary Lead Smelting Facilities and Model Comparison, EPA/OAQPS, 2001 to 2004. For EPA, ICF applied the TRIM.FaTE model to two secondary lead smelting facilities to model fate and transport of mercury, seven PAHs, and two dioxins emitted by the facilities. Mr. Burch managed ICF's support efforts for EPA, which included acquisition of site- and chemical-specific data to fulfill TRIM.FaTE model input requirements, model set-up and troubleshooting, execution of model runs, and analysis of results. ICF also conducted a complete model comparison analysis to compare the TRIM.FaTE results with results for these sites generated separately using multimedia modeling techniques based on EPA's Multiple Pathways of Exposure (MPE) methodology for the secondary lead smelting source category residual risk assessment. Results of the model comparison have been incorporated into an extensive technical report for EPA. In addition, selected results were presented via a poster presentation at the 2003 SETAC Annual Meeting in Austin, TX.

TRIM.FaTE Technical Support Document (TSD), EPA/OAQPS, 2001 to 2002. For this EPA project, Mr. Burch worked closely with the client to manage ICF's revision of the 1999 draft version of Volume I (Description of Module) of the TSD for the TRIM.FaTE fate and transport model. Key tasks included overhauling existing text to reflect changes and clarify technical concepts, technical writing of original text describing the conceptual model framework and general application of the model, incorporation of comments and revisions from TRIM team members, and management of the production of the final camera-ready version of the document. Mr. Burch was also involved with the revision and updating of Volume II of the TSD (Description of Transport and Transformation Algorithms).

TRIM.FaTE Users Guidance Documentation, EPA/OAQPS, 2001 to present. Mr. Burch led ICF's development of user guidance documentation for EPA's TRIM.FaTE fate and exposure model. This document provides a comprehensive reference for application and execution of the TRIM.FaTE model. As the ICF project lead, Mr. Burch worked with the EPA WAM and other ICF staff to develop the overall outline and organization of the guide, write technical text for specific sections of the document on set-up and execution of the model, develop flow diagrams describing user processes, respond to EPA and TRIM team comments on draft versions of the guidance, and generate the final draft of the guidance for publication on EPA's public web site and in hard copy. Mr. Burch is currently involved in follow-up work related to revising the user's guidance in preparation for a future version. In a related activity, Mr. Burch has assisted in developing user-training sessions for instructing staff on running TRIM.FaTE.

Workshop on Ecological Residual Risk Assessment Techniques, U.S. EPA, 2005-2006. Mr. Burch co-managed an effort to provide technical and organizational support to EPA's Office of Air for a 3-day workshop to elicit input on appropriate screening- and refined-level ecological risk assessment methods to be implemented in EPA's residual risk program. Technical tasks involve the development of a strawman screening-level ecological risk assessment approach for hazardous air pollutants and a case study of a detailed site-specific risk assessment.

Air Toxics Risk Assessment Library, EPA/OAQPS, 2002 to 2006. For this project, ICF assisted EPA in developing an extensive, three-volume air toxics risk assessment reference library for conducting air toxics analyses at the facility and community-scale. Mr. Burch participated in the planning meetings, outline development, and initial drafting of Volume 1 that covers the overall air toxics risk assessment process. For this volume, he was the lead author in developing the first draft of chapters on acquisition of

emissions and source data and modeling of air emissions in the atmosphere. For Volume 2, which describes the detailed aspects of facility-specific assessments, he participated in development of the document framework describing the approach to facility-specific assessments and provided more detailed text regarding screening-level and more refined dispersion modeling, multimedia fate and transport modeling, and calculating exposures for human and ecological receptors. For both volumes, he provided technical oversight and review of the final drafts provided to EPA. Volume 3 builds on the information presented in Volume 1 to describe how to evaluate and reduce risks from air toxics from multiple sources at the local community level. For Volume 3, Mr. Burch worked directly with the client to refine the document to address internal EPA and external peer review comments and develop the final version for publication. All three volumes of the Library can be found on EPA's website at [http://www.epa.gov/ttn/fera/risk\\_atra\\_main.html](http://www.epa.gov/ttn/fera/risk_atra_main.html).

Multimedia Fate and Transport/Exposure Modeling of Speciated Arsenic, EPA/OAQPS, 2002 to 2003. For this EPA project, Mr. Burch managed a task to review previous EPA modeling of arsenic exposures from secondary lead smelters and utilities. ICF reviewed the methodology implemented previously by EPA for modeling multimedia exposures to humans (i.e., via inhalation and ingestion exposure pathways), proposed a new methodology that would explicitly model As(III) and As(V) individually, implemented the methodology by adapting an existing EPA model, and performed initial testing of the new model for comparison to EPA's previous results. Benefits of the revised modeling approach in addition to the modeling of individual arsenic species included a mass balance among the primary abiotic media types included and the implementation of a differential equation solver to generate results within the mass-balanced system. To populate the model with appropriate chemical-specific data, ICF conducted a literature search, reviewed peer-reviewed articles and Agency publications, compared data obtained to the inputs used previously by EPA, and updated model inputs where appropriate. The revised software and chemical-specific model inputs produced in this project may be of use to EPA in future assessment of arsenic exposures and the development of arsenic fate and transport/exposure modeling methodologies.

RCRA Facility Investigation/Baseline Risk Assessment, Altus Air Force Base, Oklahoma, U.S. Air Force, 2000 to 2001. For the U.S. Air Force, Mr. Burch provided technical support in carrying out a baseline human health risk assessment for an active Air Force base. The risk assessment characterized baseline risk according to RCRA guidelines for over 50 sites on the base taking into account current and future (i.e., potential) exposure scenarios for on- and off-Base human receptors. Measured concentrations of chemicals in on-site environmental media were used to calculate potential risks via dermal contact with soil, groundwater, and surface water, consumption of contaminated groundwater and soil, and inhalation of volatilized chemicals in drinking water sources. Mr. Burch coordinated with staff hydrogeologists to accurately interpret site characterization data, including site hydrogeology, soil characterization, extent and potential source(s) of contamination, soil and groundwater chemical analytical results, in order to estimate human health exposures and risks. In addition, exposures via indirect pathways (e.g., indoor and outdoor exposures to airborne dust particles and volatilized chemicals from subsurface soils) were estimated using additional models. Receptor risks were then characterized using an Access-based risk assessment model. Results of the risk assessment were compiled into a summary document and used to develop appropriate corrective and remedial measures at sites requiring further action.

Screening-level Ecological Risk Assessments, U.S. Navy Facilities in the Pacific Region, U.S. Navy, 2001. Mr. Burch worked with a senior ecologist to complete ecological risk assessments at several Navy facilities under the Comprehensive Long-Term Environmental Action Navy (CLEAN) II program. Screening-level ecological risk assessments were conducted for several Pacific region facilities according to Navy CLEAN II and USEPA Superfund ecological risk assessment guidelines. Risk assessment tasks included problem formulation, screening-level exposure estimation and risk calculations, and determination of the proposed scientific management decision point outcome. For sites requiring additional work, initial baseline ecological risk assessment activities were carried out (e.g., screening of chemicals versus background concentrations, refinement of exposure and risk assessment to reflect site-specific characteristics). Technical comments on the assessments received from peer, Navy, and USEPA reviewers were addressed and appropriate changes to the assessments were implemented.

Baseline Human Health Risk Assessment, Air Force Plant 85, Ohio, U.S. Air Force, 2000 to 2001. For the Baseline Risk Assessment section of a Phase II Property Assessment Report, Mr. Burch calculated human health risks for multipathway exposures to chemicals present at sites on the facility, including risks due to airborne particles and volatilized contaminants in the soil and groundwater. Based on these results, Mr. Burch calculated preliminary remediation goals for contaminated soil and water at the site.

Hazard Analysis for Emergency Management Planning, Canadian National Railway (CN), 1999 to 2000. Mr. Burch contributed to several hazard analyses to determine relative risks from commodities shipped along CN's mainline track in the U.S. and through

several CN yards. The results of these analyses were compiled into larger reports detailing effective emergency management plans for various sectors of CN's operations.

Assessment of Aquatic Environmental Estrogen, Nicholas School of the Environment/Duke University, 1997. As a part of his graduate degree program, Mr. Burch wrote a literature review of the chemistry, toxicology, and distribution of alkylphenolic surfactants in aquatic ecosystems and the potential risks of these substances to aquatic organisms due to their estrogen-like characteristics.

#### Other Technical/Regulatory Support

Evaluation of Mercury Exposure and Toxicity, EPA/Office of Policy, Economics, and Innovation (OPEI), 2004 to 2005. In support to EPA's OPEI, Mr. Burch provided technical assistance in the development of the regulatory impact analysis (RIA) for the Clean Air Mercury Rule (CAMR) finalized in March 2005. This complex and contentious rule was focused on reducing mercury emissions from utilities nationwide. Mr. Burch served as the project manager for ICF's efforts under this assignment and worked closely with the EPA WAM and high-level EPA scientists to provide a range of technical and other support. ICF initially coordinated a series of five EPA "workshops" where scientists from various program offices met to discuss key aspects of the exposure pathway and risk characterization for mercury emissions from utilities. Mr. Burch assembled a team of ICF staffers that provided logistical support, facilitation, note-taking, and background materials at these meetings and coordinated the production of meeting summaries on a quick-turnaround basis. In support of the EPA RIA, ICF produced detailed technical memoranda summarizing current data on fish consumption rates and the effectiveness of fish consumption advisories. Mr. Burch coordinated the literature search for both of these memoranda, served as a key technical reviewer for the consumption piece, and was the primary author of the consumption advisory piece. In addition, Mr. Burch was the primary analyst and author of several sections summarizing the toxic effects of mercury based on the current literature. For the toxicity summaries, ICF worked under an extremely tight time frame to develop and revise the text according to various comments in order to meet the statutory deadline for the CAMR, and the finished pieces were incorporated in the publicly-released RIA.

Synthesis Report on Mercury Watershed Research, EPA/National Center for Environmental Research (NCER), 2004 to present. ICF is providing support to EPA's NCER in the development of science summary reports of research funded by EPA under the Science to Achieve Results (STAR) program. For this project, Mr. Burch was the lead technical writer in developing a summary report for research focused on mercury fate and transport through a watershed. Using research summaries and published articles prepared by the principal investigators, Mr. Burch led a team of analysts in developing a cohesive technical summary of key research findings that emphasizes the relevance of results within the context of EPA's research programs and to the broader scientific community. The final report is available for use by EPA program managers and research staff as well as environmental scientists and professionals in the public realm.

Residual Risk Report to Congress, EPA/OAQPS, 1997 to 1999. Mr. Burch provided technical writing and editing support to OAQPS in developing EPA's Residual Risk Report to Congress (EPA 453/R-99-001, March 1999), particularly in the development of the risk assessment methods section. He worked closely with the EPA client to respond to and incorporate numerous inter-agency and SAB comments on the Report. As the key ICF analyst for this project, Mr. Burch was instrumental in assisting EPA in the production of the final version of the Report.

Mercury Study Report to Congress, EPA/OAQPS, 1997 to 1998. For EPA's Office of Air, Mr. Burch assisted in the development and revision of the eight-volume Mercury Report. His primary responsibility was in the development of Volume III, Fate and Transport of Mercury. Duties included reorganization of volume in accordance with the primary authors' comments and suggestions, incorporation and editing of EPA-produced material into the document, review of peer-reviewed literature for incorporation into the report, technical writing of report sections, and preparation of camera-ready documents for all volumes. Mr. Burch also contributed to the preparation of the final summary document detailing EPA responses to the Science Advisory Board's comments on the Mercury Report.

Review and Evaluation of REACH Proposed Ecological Toxicity Test Methods, Private client, 2003. For a major U.S. chemical industry trade association, Mr. Burch assisted in the review of selected test methods for ecological toxicity included in the European Commission's proposed 2003 REACH (Registration, Evaluation, Authorization of Chemicals) System and a comparison with the corresponding OECD test guidelines. The evaluation consisted of three steps: (1) identify corresponding OECD and EPA/OPPTS test guidelines for all REACH test guidelines; (2) identify REACH test guidelines to review and evaluate; and (3) compare the test guidelines and summarize findings. After reviewing the test methods, a crosswalk was developed to link

the proposed REACH methods with existing OECD and EPA test methods, and key similarities and differences between the test setup, experimental methods, and data processing and reporting requirements were summarized. The results of the comparison were used to make a determination of the likelihood that existing OECD test methods would be adequate for REACH purposes.

Cost Analysis of Proposed California Chemical Test Methods (Legislation AB 289), Private client, 2005. Mr. Burch was the key technical analyst and writer for a 2005 analysis of the estimated governmental costs associated with proposed California legislation requiring chemical data and test methods for chemicals produced in or imported into the state. This analysis, completed for a major U.S. chemical industry trade association, estimated initial and recurring annual labor costs based on the expected activities and expertise required to develop the testing guidelines, establish the infrastructure for collecting and maintaining data from regulated industries, process and review chemical data and analysis results, ensure compliance, and compile production reports and other documentation required under the legislation. The analysis also included a summary of specific changes made to predecessor legislation and a brief discussion of the impact of these changes, a comparison of the estimated government costs for other, similar programs, and an estimate of additional costs to the state that might be incurred if other selected program elements were included. Results were compiled into a 20-page technical memorandum that provided a breakdown of costs and data supporting cost estimates. Also prepared in conjunction with this effort was a related analysis of key issues that must be resolved by the state of California to effectively implement the proposed program, including technical issues related to exactly what would be required by the legislation (e.g., aspects of the bill that are unclear regarding what chemicals would be covered or how methods would be deemed appropriate) and practical questions as to how the state would effectively implement the bill, from the standpoint of compliance, cost, and attainment of the bill's ultimate goals (i.e., protection of human health).

Staff Executive, Industry Technical Implementation Panel, Private Client, 1998 to 2000. Mr. Burch was under contract as staff executive for a U.S. chemical industry trade association's Exposure Assessment Technical Implementation Panel (TIP), a task group of chemical industry representatives formed to allocate resources for exposure assessment research. Mr. Burch worked closely with the panel chair and association staff to organize panel meetings and ensure that the goals of the panel were pursued efficiently and in proper accordance with policies. Primary duties included drafting agendas, minutes, summaries of proposed research projects, and other documents in addition to coordinating communication between members of the panel. As staff executive, Mr. Burch was instrumental in the organization of a 2-day research forum sponsored by the TIP that included over 40 research scientists from private and government organizations in the U.S. and elsewhere in addition to key industry representatives.

Risk Management Program, CEPPO, 1997 to 1999. For EPA's Chemical Emergency Preparedness and Prevention Office (CEPPO), Mr. Burch assisted in preparing the Risk Management Program Guidance for Offsite Consequence Analysis. Duties included technical quality assurance, editing, and preparation of the final version of the document in hard copy and as a web-ready, electronic version. Mr. Burch also assisted in the technical review of RMP\*Calc, the Windows-based calculator used to estimate toxic/flammable endpoints for facilities using hazardous substances.

Fuel Oxygenates in Groundwater, EPA/OUST, 1999. For EPA's Office of Underground Storage Tanks, Mr. Burch identified and summarized laboratory methods used in the analysis of fuel oxygenates in groundwater. For this project, Mr. Burch gathered data through review of published methods and conversations with relevant laboratories, scientists, and government agencies and prepared a technical memorandum summarizing results of the research and the recommended analytical procedures for fuel oxygenates.

Waste Minimization Prioritization Tool (WMPT), EPA/OSW, 1998 to 1999. For an Office of Solid Waste client, Mr. Burch completed several quick-response tasks related to technical aspects of the WMPT. Subjects covered included: available methods of estimating and calculating the octanol-water partition coefficient (Kow) for a wide range of compounds; establishing "fencelines" used in the scoring of chemicals according to persistence, bioaccumulation, and toxicity; and the availability and data requirements of spreadsheet-based fugacity models.

Industry Trend Analyses and Data Searches, Private client, 1998 to 1999. Mr. Burch provided as-needed technical assistance in 1998 and 1999 to a major U.S. chemical industry trade association related to various scientific topics relevant to the chemical industry. Examples of projects completed include trend analyses of chemical production and releases, a summary of U.S. and EU exposure guidelines for phthalates, a report on dioxin releases by various industry types, and a summary report on Federal regulatory pressures on the chlorine industry. Mr. Burch also attended regular task group meetings and provided administrative

support to the group by preparing meeting summaries, coordinating logistics for group meetings, preparing meeting presentation materials, and carrying out other related tasks.

Analysis of EPA's High Production Volume (HPV) List, Private Client, 1998 to 1999. For a major U.S. chemical industry trade association, ICF analyzed over 2,800 chemicals on the HPV list to determine data availability for these chemicals. Mr. Burch assisted in the initial characterization of the chemicals on the list and was a key technical analyst in a comprehensive literature review of chemical data for HPV chemicals. Citations and abstracts were evaluated for relevant data (e.g., physical/chemical characteristics, environmental fate) and the information was entered in a master database.

### Synthetic Organic Chemistry

Synthetic Medicinal Chemistry, National Institute on Drug Abuse (NIDA), National Institutes of Health (NIH), and other Federal and private clients, 1993-1995. Mr. Burch worked for over two years at Research Triangle Institute (RTI) as a bench chemist in an organic chemistry laboratory focusing on medicinal chemistry. Primary tasks in this position involved the synthesis, purification, and analysis of various organic forensic substances. Much of his work focused on the synthesis of cannabinoid and related compounds for use as standards, synthetic intermediates, and pharmacological test substances; other work involved the synthesis of developmental anti-cancer and anti-nerve gas agents. In addition to acquiring skills fundamental to the synthesis of organic compounds, Mr. Burch became experienced in standard laboratory purification and analytical techniques, including separation of gross chemical fractions (e.g., by liquid column chromatography) and identification and quantification of chemical products (e.g., via thin layer chromatography, gas chromatography, high-performance liquid chromatography, nuclear magnetic resonance techniques, mass spectrometry, and other methods). His primary achievement at RTI was the completion of the complex multi-step synthesis, purification, radiolabeling (via tritiation), and structural confirmation of a novel cannabinoid antagonist. The results of this project were incorporated into two journal publications on which Mr. Burch was listed as a co-author.

### Additional Experience and Training

Forest Delineation, 2001. For a suburban county parks and recreation department, Mr. Burch assisted a senior ecologist in completing a delineation of undeveloped forested areas owned by the county. Technical tasks involved identification, measurement, and quantification of trees, shrubs, and undergrowth in the areas of study, delineation of forest types based on results of the plant survey, and documentation of observations for incorporation into a delineation report. Results of the study were used by the county for land-use planning purposes.

Wetland Resources Training and Research, Nicholas School of the Environment/Duke University, 1996-1997. Mr. Burch has undergone formal training for the delineation of wetland areas through the identification of wetland plants, soils, and hydrology. He has also worked as a member of a research laboratory studying the impacts of phosphorus enrichment in the Florida Everglades. Specific duties with this team included carrying out soil and water analyses (i.e., measurements of phosphorus, metals, and other constituents in water and soil samples), data collection and organization, and laboratory investigations into the accuracy of analytical procedures for measuring phosphorus concentrations in soil samples.

### SELECTED PUBLICATIONS AND PRESENTATIONS

- David Burch, Mark Lee, Randy Maddalena, and Deirdre Murphy. 2005. Steady-state Application of the TRIM.FaTE Model. Presentation at 2005 Carolinas' SETAC Chapter Meeting, March 31 to April 2, 2005, Raleigh, NC. [Primary author and presenter.]
- Randy Maddalena, David Burch, Matt MacLeod, and Mark Lee. 2004. Atmospheric Dispersion versus Compartmental Mass Balance: A Model Comparison. Poster presentation at SETAC 25<sup>th</sup> Annual Meeting, November 8-11, 2004, Portland, OR.
- Burch, D.F., Lee, R.M., Jones, B., Dusetzina, M. 2003. TRIM.FaTE Application and Model Comparison for Organic Compounds and Mercury. Poster presentation at SETAC 24<sup>th</sup> Annual Meeting, November 10-13, 2003, Austin, TX. [Primary author and presenter.]
- Murphy, D.L., Jones, B., Lee, R.M., Burch, D. 2003. TRIM.FaTE Test Case: Distribution of Hg Mass and Concentrations Among Environmental Compartments. Presentation at SETAC 24<sup>th</sup> Annual Meeting, November 10-13, 2003, Austin, TX.

- Bennett, D.H., D.F. Burch, B.F. Lyon, and D.L. Murphy. 2000. Spatial resolution of TRIM.FaTE, a fate, transport, and ecological exposure model for air pollutants. Presentation at SETAC 21<sup>st</sup> Annual Meeting, November 12-16, 2000, Nashville, TN.
- Lee, R., D. Burch, B. Lyon, and D. Murphy. 2000. Model performance evaluation of TRIM.FaTE, a fate, transport, and ecological exposure model for air pollutants. Presentation at SETAC 21<sup>st</sup> Annual Meeting, November 12-16, 2000, Nashville, TN.
- Burch, D. F. 1997. Alkylphenolic Surfactants as Environmental Estrogens: Presence, Effects, and Consequences for Fish. Master's project completed as part of graduate study at Duke University. May 1997.
- Thomas, B. F., A. F. Gilliam, D. F. Burch, M. J. Roche, and H. H. Seltzman. 1998. Comparative receptor binding analyses of cannabinoid agonists and antagonists. *Journal of Pharmacology and Experimental Therapeutics*. 285:285-292.
- Seltzman, H. H., F. I. Carroll, J. P. Burgess, C. D. Wyrick, and D. F. Burch. 1995. Synthesis, spectral studies and tritiation of the cannabinoid antagonist SR141716A. *Journal of the Chemical Society, Chemical Communications*. July: 1549-1550.
- Scientific peer reviewer for *Integrated Environmental Assessment and Management* (1 article, September 2004).

## PROFESSIONAL AFFILIATIONS

Society of Environmental Toxicology and Chemistry, Member  
Society for Risk Analysis (Research Triangle Chapter), Member

## EMPLOYMENT HISTORY

ICF Consulting	Project Manager	2004-present
ICF Consulting	Senior Associate	2001-2004
Earth Tech Engineering and Environmental Services	Environmental Scientist	2000-2001
ICF Consulting	Senior Associate	1999-2000
	Associate	1997-1999
Duke Wetland Center, Duke University	Graduate Research Assistant	1996-1997
Aquatic Ecotoxicology Laboratory, Duke University	Graduate Research Assistant	1995-1996
Research Triangle Institute	Synthetic organic chemist	1993-1995
GES Environmental	Environmental Technician	Summer 1992

**YiHua Wei****ICF International****EDUCATION**

MS, Atmospheric science, State University of New York at Albany, 1988

MS, Physics, Indiana State University, 1986

BS, Physics, Nanjing University, China, 1982

**EXPERIENCE**

Ms. YiHua Wei, senior scientist at ICF International, received her MS in atmospheric science from State University of New York at Albany; her MS in physics from Indiana State University; and her BS in physics from Nanjing University, China. Her areas of expertise are air quality modeling, emission inventory development and preparation, and air toxics risk assessment. Currently, she plays a principal role in the development of the base-case and future-year emission inventories for UAM-V, REMSAD and CMAQ modeling, which include emission inventories for the Southern Company's 2018 CMAQ Sulfur tagging modeling. She played a major role in preparing base-case and future-year emission inventories for the Coastal Impact Assistance Program (CIAP) air quality modeling, Arkansas-Mississippi-Tennessee Ozone Study (ATMOS), Gulf Coast Ozone Study (GCOS) Phase III, national PM, Nitrogen and mercury tagging, West Florida Ozone Study (WFOS), South Carolina Ozone Study, and Office of Transportation and Air Quality (OTAQ) projects, and in preparing national criteria pollutants and mercury inventories for REMSAD modeling for CAMD, LADCO, and OW projects, using EPS2.5. She has worked on a project of cumulative exposure study and performed analysis of the modeling results of the Assessment System for Population Exposure Nationwide (ASPEN) for five years. She has applied the Gaussian dispersion model (ISC3) for regulatory and toxic risk assessment analysis; applied CAL3QHC to predict pollutant concentrations near roadway intersections; she also applied CALPUFF (a non-steady state Lagrangian puff model) to model pollutant concentrations for the Macedonia, Thailand, and Georgetown University projects. She has also applied EPS 2.0 and the UAM Biogenic Emission Inventory System (UAM-BEIS2) to generate seasonal toxic and particulate emission inventories for the entire U.S. She played the major role in preparations of regional emission inventories for UAM simulations of the MMS project, applying NO<sub>x</sub> controls for the northeast Ozone Transport Region (OTR), and NIMO point sources for the future-year emission inventories. Before joining SAI, Ms. Wei held the position of associate air quality meteorologist at ENSR Consulting and Engineering in Acton, Massachusetts. She was responsible for modeling and environmental assessment of air quality

**PROJECT EXPERIENCE****Emission Inventory Development and Processing**

Ms. Wei has twelve years of experience in emission inventory development and processing. Currently, she plays a principal role in the development of the base-case and future-year emission inventories for UAM-V, REMSAD and CMAQ modeling, which include emission inventories for the Southern Company's 2018 CMAQ Sulfur tagging modeling. She played a major role in preparing base-case and future-year emission inventories for the Coastal Impact Assistance Program (CIAP) air quality modeling, Arkansas-Mississippi-Tennessee Ozone Study (ATMOS), Gulf Coast Ozone Study (GCOS) Phase III, national PM, Nitrogen and mercury tagging projects. She also prepared national Hazardous Air Pollutants (HAPs) emission inventories for the EPA's cumulative exposure study.

**Air Quality Modeling**

Ms. Wei has been involved in air quality modeling for more than ten years. She has applied Gaussian dispersion model (ISC3) for numerous regulatory and toxic risk assessment analysis projects. In the past year, she has worked on the EPA Residual Risk Assessment for the Cokeoven Facilities using ISCST. She also applied CAL3QHC to predict the pollutant concentrations near the roadway intersections and CALPUFF to model the pollutant concentrations.

**Air Toxics Health Risk Assessments**

Ms. Wei played a major role in EPA's cumulative exposure project for a period of five years, performed analysis of the modeling results of the Assessment System for Population Exposure Nationwide (ASPEN) including comparison of model predicted HAP concentration with monitored ambient air quality data. She was principal author of the "User's Guide: Assessment System for Population Exposure Nationwide (ASPEN) Model". She developed new features for the ASPEN model, and revised the associate post-processors and utility, prepared test cases for the entire ASPEN simulation procedure, and installed the ASPEN model, post-processing software and associated utilities on the EPA workstation.

## SELECTED PUBLICATIONS AND PRESENTATIONS

- "Final Report: Gulf Coast Ozone Study (GCOS) Modeling Analysis Phase III: Additional Future-Year Assessments" (with others), prepared for SESARM, FDEP, ADEM, MDEQ, LDEQ and SCS, (2005)
- "Gulf Coast Ozone Study (GCOS) Modeling Analysis: Phase II Methods and Results." (with others), SYSAPP-04-024 prepared for SESARM and Gulf Coast Ozone Study Operations Committee, (2001)
- "Final Report: Development of High-Resolution Modeling Database for the Northeastern U.S. and Application of the UAM-V to the Northeastern U.S." (with others), SYSAPP-2005r1, prepared for Honda R&D Co. Ltd., (2000)
- "Final Report: Estimation of Effects of Air Conditioner-based Ozone Scavenging and NOx Emission Reduction on Ozone Levels in Houston and Dallas, Texas." (with others), SYSAPP-2009, prepared for Engelhard Corporation, (2000)
- "Final Report: Estimation of Effects of Air Conditioner-based Ozone Scavenging and NOx Emission Reduction on Ozone Levels in Sacramento, California." (with others), SYSAPP-2012, prepared for Engelhard Corporation, (2000)
- "Revised Final Report: Modeling Cumulative Outdoor Concentrations of Hazardous Air Pollutants" (with others), SYSAPP-99-96/33r2, prepared for U.S. EPA Office of Policy, Planning, and Evaluation (1999)
- "User's Guide: Assessment System for Population Exposure Nationwide (ASPEN Version 1.1) Model" (with others), SYSAPP-98/25r2, prepared for U.S. EPA Office of Air Quality Planning and Standards, Emission, Monitoring, and Analysis Division (1999)
- "Modeling Cumulative Outdoor Concentrations of Hazardous Air Pollutants" (with others), SYSAPP-98-96/33r1, prepared for U.S. EPA Office of Policy, Planning, and Evaluation (1998)
- "User's Guide: Assessment System for Population Exposure Nationwide (ASPEN) Model" (with others), SYSAPP-98/25r1, prepared for U.S. EPA Office of Air Quality Planning and Standards, Emission, Monitoring, and Analysis Division (1998)
- "Estimate of the Effect of an Ozone Control Strategy Focusing on Air Conditioning – Bound Catalysts for Ozone Scrubbing" (with others), SYSAPP-97/59, prepared for South Coast Air Quality Management District (1997)
- "Revised AB2588 Health Risk Assessment for Owens Corning, Santa Clara, California" (with others), SYSAPP-94/31r1, prepared for Owens Corning (1997)
- "Revised Methodology for Modeling Cumulative Exposures to Air Toxics I: Outdoor Concentrations" (with others), SYSAPP-96/33d, prepared for U.S. EPA Office of Planning, Policy, and Evaluation (1996)
- "Sacramento FIP 2005 Modeling Inventory" (with others), SYSAPP-93/237, prepared for Pacific Environment Services, Inc. and U.S. EPA Region 9 (1993)
- "AB-2588 Health Risk Assessment for ARCO Transportation's Tejon Pumping Station, Kern County, CA" (with others), Volume IV, Addendum, SYSAPP93-91/037D, prepared for ARCO Transportation (1993)
- "Ozone Modeling in Support of the Federal Implementation Plan for Sacramento, California: Future Case and Control Strategies" (with others), SYSAPP-93/037, prepared for Pacific Environment Services, Inc., and U.S. EPA Region IX (1993)
- "Sacramento FIP Modeling 3: Future Emission Inventory" (with others), SYSAPP-93/036, prepared for Pacific Environment Services, Inc. and U.S. EPA Region IX (1993)
- "Modeling Protocol to Conduct NO<sub>2</sub> Dispersion Analysis for Hallburton Services' Operations at Freeman Island in the Thums Island" (with others), SYSAPP-92/118, prepared for Omnibus Environment Services (1992)
- "Assessment of Cancer Risk Associated with Methylene Chloride Emissions per Proposition 65" (with others), SYSAPP-92/078, prepared for Syntex (1992)
- "Modeling Analysis to Predict 1 Hour Ambient SO<sub>2</sub> Concentrations for Ashland St. Paul Park Refinery" (with others), SYSAPP-92/035, prepared for Ashland Oil Inc. (1992)
- "AB-2588 Health Risk Assessment for ARCO Product's West Sacramento Tank Terminal" (with others), SYSAPP-92/013, prepared for ARCO Product Company (1992)
- "Verification of NYSDEC's 17 July 1991 Emission Inventory for Inter-Power's PSD Permit Application for the Halfmoon Cogeneration Plant" (with others), SYSAPP-91/128, prepared for U.S. EPA, Office of Air Quality Planning and Standards (1991)

- "Photochemical Modeling of Four Areas in Texas, Volume III: UAM Application for Dallas-Ft. Worth" (with others), SYSAPP-91/120c, prepared for the Texas Air Control Board (1991)
- "AB-2588 Health Risk Assessment for Unocal's Los Angeles Refinery" (with others) SYSAPP-91/076, prepared for Unocal Refinery and Marketing Division, Unocal Corporation (1991)
- "Alternative Analysis to Supplement AB 2588 Health Risk Assessment for Unocal's Los Angeles Refinery" (with others), SYSAPP-91/076s, prepared for Unocal Refining and Marketing Division (1991)
- "AB-2588 Health Risk Analysis for ARCO Transportation's Tejon Pumping Station" (with others), SYSAPP-91/073, prepared for ARCO Transportation (1991)
- "AB-2588 Health Risk Assessment for ARCO Oil and Gas Derby Acres Facility" (with others), SYSAPP-91/066, prepared for ARCO Oil and Gas (1991)
- "AB-2588 Health Risk Analysis for United Technologies Chemical System" (with others), SYSAPP-91/015, prepared for United Technologies Chemical Systems Division (1991)
- "AB-2588 Health Risk Analysis for Owens-Corning Fiberglas, Inc." (with others), SYSAPP-91/009, prepared for Owens-Corning Fiberglas, Inc. (1991)
- "Modeling Protocol for United Technologies Health Risk Assessment" (with others), SYSAPP-90/133, prepared for United Technologies Chemical Systems Division (1990)

#### EMPLOYMENT HISTORY

ICF International/SAI	Senior Associate	1990–present
ENSR Consulting and Engineering	Associate Air Quality Meteorologist	1989–1990
Atmospheric Research Center, State University of New York, Albany, New York	Research Assistant	1987–1988

## A. Belle Hudischewskyj

## ICF International

### EDUCATION

B.S., Meteorology, California State University, San Jose, 1980  
A.S., Mathematics, Sierra Junior College, 1977

### LICENSES

General Building Contractors License, Class B, (California Contractors State License Board, License #746448)

### EXPERIENCE

Ms. Hudischewskyj, Senior Associate at ICF International, received her B.S. in meteorology from California State University, San Jose. Her areas of specialization are meteorological and air quality data analysis and meteorological modeling. She also frequently provides quality assurance checks on data/inputs prepared by others. Most recently (and currently), Ms. Hudischewskyj has conducted Classification and Regression Tree (CART) analyses to investigate air quality and meteorological relationships for projects involving forecasting and modeling episode selection. Ms. Hudischewskyj also performs meteorological modeling, using MM5, to analyze and assemble meteorological data for UAM-V modeling, and to evaluate the UAM-V air quality modeling system. She has also participated in the preparation and quality assurance of UAM and UAM-V inputs and performed the UAM and UAM-V modeling for several SIP modeling applications including those for Las Vegas, Cincinnati, Atlanta, Baton Rouge, and Phoenix. She also served as principal investigator for a CO modeling study for Spokane, WA that involved both meteorological and air quality modeling. In addition, she has also performed work relating to the application of air quality indicators for use in illustrating progress being made as a result of provisions of the Clean Air Act Amendments of 1990 (CAAA) pertaining to air toxics, also known as hazardous air pollutants (HAPs). Previously, she also conducted air dispersion modeling studies and air toxics health risk assessments. Ms. Hudischewskyj regularly quality-assures data and work products prepared by others.

### PROJECT EXPERIENCE

#### Project Management

Lower Fraser Valley August 7-10, 1993 Meteorological Fields. Ms. Hudischewskyj served as the day-to-day project manager for a project during which UAM-V model ready meteorological inputs were prepared. She oversaw the preparation of pre-processed meteorological and air quality data, as well as performed the meteorological modeling. She kept track of budget and interacted with the client.

Spokane Regional Transportation Add-On. Ms. Hudischewskyj was the project manager for two add-on projects for the Spokane Regional Transportation Commission. Ms. Hudischewskyj budgeted the project, coordinated the work of co-workers, conducted UAM-V modeling of Carbon Monoxide (CO), and served as primary client contact. Ms. Hudischewskyj was also the day-to-day manager for the original UAM-V CO modeling effort.

Urban Heat Island Mitigation Study. Ms. Hudischewskyj served as day-to-day project manager for a project for EPA in which air quality modeling was performed to examine the effects of urban heat island mitigation measures on several cities in the Northeastern U.S. She assisted in the original budgeting, met with the clients, oversaw the work of co-workers, and kept track of budget and progress.

Preparation of Non-Emissions-Related Inputs for Application of the UAM-V Modeling System to the Western U.S. Ms. Hudischewskyj was the day-to-day manager for a project that involved the conversion of MM5 meteorological fields into UAM-V model-ready fields. She was the client contact and made sure the schedule and budget goals were met.

#### Meteorological and Air Quality Modeling

Arkansas-Tennessee-Mississippi Ozone Study (ATMOS). Ms. Hudischewskyj set up and ran the MM5 meteorological model and post-processed the results to prepare UAM-V ready inputs for a regional-scale episode. Modeling was for the determination of the need and potential for local controls needed to comply with an 8-hour ozone National Ambient Air Quality Standard (NAAQS).

South Carolina 8-hour Ozone Modeling Study (SC DHEC). Ms. Hudischewskyj set up and ran the MM5 meteorological model and post-processed the results to prepare UAM-V model-ready inputs for a regional-scale episode. Modeling was done to provide technical information relevant to attainment of an 8-hour NAAQS for ozone in South Carolina.

Lake Charles 8-hour Ozone Modeling Study. Ms. Hudischewskyj set up and ran the MM5 meteorological model and post-processed the results to prepare UAM-V model-ready inputs for two regional-scale episodes. Modeling was done to provide technical information relevant to attainment of an 8-hour NAAQS for ozone in the Lake Charles, Louisiana area.

Lower Fraser Valley August 7-10, 1993 Meteorological Fields. Ms. Hudischewskyj prepared UAM-V model-ready meteorological inputs, using SAIMM, for four days that were the continuation of a previously modeled period. For this project she quality-assured and pre-processed the raw data, as well as set up and ran the SAIMM and the SAIMM to UAM-V input converter. She also analyzed the results and prepared the final report summarizing the results.

Regional Carbon Monoxide Dispersion Modeling for the Spokane Serious Nonattainment Area Plan. Ms. Hudischewskyj was the principal investigator for a CO modeling study for Spokane, WA that involved both meteorological and air quality modeling. She prepared the meteorological fields using the SAIMM for thirteen CO episodes for the Spokane area and also ran the UAM-V, analyzed the results, and prepared the final report. She also served as the day-to-day manager for the project and follow-on work.

Gulf Coast Ozone Study. Ms. Hudischewskyj set up and ran the MM5 meteorological model and post-processed the results to prepare UAM-V model-ready inputs for three regional scale episodes for the Gulf Coast Ozone Study (24-31 August 1997, and 4-9 July 1998, and 20-24 May 1998). This involved running the model for five (nested) grids for each episode.

Louisiana Department of Environmental Quality. Ms. Hudischewskyj set up and ran the MM5 meteorological model and post-processed the results to prepare UAM-V model-ready inputs for one regional-scale ozone episode for the Louisiana Department of Environmental Quality (1-9 August 1999). This involved running the model for five (nested) grids for each episode.

UAM Modeling Analysis of the Clark County/Las Vegas Valley Area. For this project, Ms. Hudischewskyj prepared the UAM-V model-ready meteorological inputs for Clark County. This involved gathering raw data, running both the SAIMM and DWM meteorological models, and pre-processing the data for UAM-V.

Application of the Urban Airshed Model to Baton Rouge, Louisiana for Three Additional Multi-Day Ozone Episodes. For this project, Ms. Hudischewskyj prepared the UAM model-ready meteorological inputs and conducted the base-case and future-year air quality modeling for three multi-day ozone episodes. This involved gathering raw data, running meteorological and air quality pre-processors, and quality assurance of the data.

## Data Analysis

Analysis of the Relationships between Meteorology and Ozone for Several Southern Cities. For this project, Ms. Hudischewskyj created databases for and used Classification and Regression Tree (CART) analysis to examine the relationships between meteorological conditions and ozone concentrations. This was done to address several key questions related to causes of exceedances of the National Ambient Air Quality Standard for 8-hour ozone, regional variations in the factors influencing high ozone concentrations throughout the South east, and the ability of selected subsets of the ozone season to represent the type and range of conditions that define the air quality characteristics of a given area and region.

Episode Selection Analysis for 8-Hour Ozone For Northern Georgia/Northern Alabama Area. For this project, Ms. Hudischewskyj used Classification and Regression Tree (CART) analysis to identify ozone episode periods that are representative of the meteorological and air quality conditions most frequently associated with exceedances of the federal ozone standard in the Northern Georgia / Northern Alabama area. The episodes are being selected for use in photochemical modeling.

Episode Selection Analysis for 8-Hour Ozone for the Gulf Coast Area. For this project, Ms. Hudischewskyj used CART analysis to identify ozone episode periods that are representative of the meteorological and air quality conditions most frequently associated with exceedances of the federal ozone standard in the Gulf Coast (Pensacola, Pascagoula, Mobile, Port Bienville, Gulfport) area. The episodes are being selected for use in photochemical modeling.

Development of CART-Based Ozone Forecasting Tool for the Memphis Area. For this project, Ms. Hudischewskyj performed (CART) analysis on historical meteorological and ozone data in the Memphis area. Results will be transformed into a computer-based tool for forecasting ozone at individual sites in the area.

Development of CART-Based PM<sub>2.5</sub> Forecasting Tools for Selected Cities within the MARAMA Region. For this project, Ms. Hudischewskyj performed (CART) analysis on historical meteorological and PM<sub>2.5</sub> data in multi areas within the MARAMA Region. Results were transformed into computer-based tools for forecasting PM<sub>2.5</sub> concentrations in the individual areas.

Frequency of Impact of Georgia Power Facilities on Ozone Exceedances in the Atlanta Area. For this project, Ms. Hudischewskyj performed statistical analysis of meteorological data to determine the (possible) frequency of impact of Georgia Power Facilities on elevated ozone concentrations in the Atlanta, GA area.

Identification of Candidate Modeling Episodes for the Atlanta Ozone Nonattainment Area Considering Both a One-Hour and an Eight-Hour Standard. For this project, Ms. Hudischewskyj used Classification and Regression Tree (CART) analysis to identify ozone episode periods that are representative of the meteorological and air quality conditions most frequently associated with exceedances of the federal ozone standard in the Atlanta, GA area. The episodes were selected for potential use in photochemical modeling.

Identification of Candidate Modeling Episodes for the Birmingham Ozone Nonattainment Area Considering Both a One-Hour and an Eight-Hour Standard. For this project, Ms. Hudischewskyj used CART analysis to identify ozone episode periods that are representative of the meteorological and air quality conditions most frequently associated with exceedances of the federal ozone standard in the Birmingham, AL area. The episodes were selected for potential use in photochemical modeling.

Episode Selection Analysis for 8-Hour Ozone For Selected Areas Along the Eastern Gulf Coast. For this project, Ms. Hudischewskyj used CART analysis to identify ozone episode periods that are representative of the meteorological and air quality conditions most frequently associated with exceedances of the federal ozone standard in the Gulf Coast Area. The episodes were selected for use in photochemical modeling.

Classification of Ozone Episodes for Four Southern Cities According to Transport Characteristics. For this project, Ms. Hudischewskyj used CART analysis to characterize, for each of four urban areas (Atlanta, Birmingham, Charlotte, and Nashville), days on which the federal ozone standard was exceeded as either predominantly "home grown" or resulting from pollutant transport.

Episode Selection Analysis for 8-Hour Ozone for South Carolina. For this project, Ms. Hudischewskyj used CART analysis to identify ozone episode periods that are representative of the meteorological and air quality conditions most frequently associated with exceedances of the federal ozone standard in South Carolina. The episodes were selected for use in photochemical modeling.

Episode Selection Analysis for 8-Hour Ozone for the Lake Charles, Louisiana Area. For this project, Ms. Hudischewskyj used CART analysis to identify ozone episode periods that are representative of the meteorological and air quality conditions most frequently associated with exceedances of the federal ozone standard in the Lake Charles Area. The episodes were selected for use in photochemical modeling.

Episode Selection Analysis for 8-Hour Ozone For the Arkansas-Tennessee-Mississippi (ATMOS) Area. For this project, Ms. Hudischewskyj used CART analysis to identify ozone episode periods that are representative of the meteorological and air quality conditions most frequently associated with exceedances of the federal ozone standard in the Arkansas-Tennessee-Mississippi area. The episodes were selected for use in photochemical modeling.

Examination of Inter-Variable Relationships and Implications for Modeling Episode Selection using the 1999/2000 Search Database. For this project, Ms. Hudischewskyj used CART analysis to characterize, for eight sites, relationships between aerosols and other geographical and meteorological factors that influence the phenomenon of regional haze in the southeastern U.S.

## **Risk Assessment**

### **AB 2588 Health Risk prepared for Confidential Client**

For this project, Ms. Hudischewskyj gathered and assembled emissions and meteorological data, performed ISC modeling, and prepared an AB-2588 risk assessment for a facility in California's Central Valley. The project required her to make a site visit to inspect the facility layout and its relation to the neighboring community.

AB-2588 Health Risk Assessment for Unocal's Los Angeles Refinery. For this project, Ms. Hudischewskyj assisted in the compilation of meteorological data, and performed dispersion modeling necessary to the preparation of an AB-2588 Health Risk Assessment.

Dispersion Modeling for Estimating PAH Exposure from Aluminum Smelter Operations in the Tacoma, Washington Area. For this project, Ms. Hudischewskyj performed dispersion modeling and receptor analysis as part of a health risk assessment of a facility in the Tacoma, Washington area.

#### Technology/Transfer

UAM Modeling Analysis of the Clark County/Las Vegas Valley Area. In addition to other tasks completed for this project, Ms. Hudischewskyj was a presenter in a training workshop for the Clark County Department of Comprehensive Planning. Ms. Hudischewskyj gave training in the use of preprocessor programs that are used for the preparation of inputs for the UAM as well as training in the use of the meteorological models. She also organized the data and programs and transferred them to the Clark County Department of Comprehensive Planning.

Petroleum Energy Center UAM Training. Ms. Hudischewskyj provided hands-on training in the use of the SAIMM and meteorological preprocessors used in preparing input files for the UAM. She also organized material and was involved in the transfer of the programs.

#### SELECTED PUBLICATIONS AND PRESENTATIONS

- "Use of CART for Air Quality Analysis and Forecasting" presented at the 2004 CART Data Mining Conference, San Francisco, California, 23 March 2004
- "Development and Pilot Application of Air Quality Indicators" (with A. S. Rosenbaum, J. B. Hemby, and J. P. Cohen), in *Measurement of Toxic and Related Air Pollutants '98*, Air & Waste Management Association, Sewickly, Pennsylvania (1998)
- "Assessment of UAM Model Performance for the 27 August 1987 Base-Case Simulation" (with S. G. Douglas), technical memorandum, prepared for Dr. Haider Taha, Lawrence Berkeley Laboratory, Berkeley, California (1994)
- "An Assessment of Regional Transport in the Sacramento, California Area Using Wind Fields Generated by a Prognostic Meteorological Model" (with N. K. Lolk and S. G. Douglas), presented at the Session M4 - Meteorological Modeling Regional Photochemical Air Quality Measurement and Modeling Studies International Specialty Conference, San Diego, California, 7-12 November 1993
- "Development of an Objective Procedure for Classifying Ozone Episodes in California by Source-Receptor Relationships" (with T. E. Stoeckenius), presented at the Session FM1 - Ozone Concentrations-Influence of Meteorology Regional Photochemical Air Quality Measurement and Modeling Studies International Specialty Conference, San Diego, California, 7-12 November 1993
- "Receptor and Dispersion Modeling of Aluminum Smelter Contributions to Elevated PM10 Concentrations" (with R. G. Ireson and H. A. Gray), presented at the 84th Annual Meeting & Exhibition of the Air & Waste Management Association, Vancouver, B.C., 16-21 June 1991
- "Classification of Los Angeles Basin Ozone Episodes on the Basis of Meteorological Conditions" (with T. E. Stoeckenius), presented at the 84th Annual Meeting & Exhibition of the Air & Waste Management Association, Vancouver, B.C., 16-21 June 1991
- Mathematical modeling of the chemistry and physics of aerosols in plumes (with C. Seigneur), *Environ. Sci. Technol.*, 23(4):413-421 (1989)
- "Statistical Analysis of Concentrations of Toxic Air Pollutants in California and Louisiana" (with T. J. Permutt, M. Moezzi, and C. S. Burton), presented at the 80th Annual Meeting of the Air Pollution Control Association, New York, 21-26 June 1987
- "Simulation of the Formation of Acidic Aerosol Species in Power Plant and Smelter Plumes" (with C. Seigneur), presented at the 79th Annual Meeting of the Air Pollution Control Association, Minneapolis, Minnesota, 22-27 June 1986
- "Mathematical Modeling of Light Scattering by Secondary Aerosols" (with P. Saxena and C. Seigneur), presented at the Air Pollution Control Association International Specialty Conference on Visibility Protection, Grand Teton National Park, Wyoming, 7-10 September 1986
- A comparative study of equilibrium approaches to the chemical characterization of secondary aerosols (with co-workers), *Atmos. Environ.*, 20(7):1471-1483 (1986)

- Simulation of aerosol dynamics: a comparative review of mathematical models (with others), *Aerosol Science and Technology*, 5:205-222 (1986)
- "Rationale for Selecting a Distribution Reflecting the Variability of PM10/TSP Relationships" (with others), presented at the 77th Annual Meeting & Exhibition, Air Pollution Control Association (1984)
- Formation and evolution of sulfate and nitrate aerosols in plumes (with C. Seigneur and P. Saxena), *Science Total Environment*, 23:283-292 (1982)

#### Selected Company Reports

- "Analysis of the Relationships between Meteorology and Ozone for Several Southern Cities" (with S. Douglas, S. Beckman), SYSAPP-05-0078, prepared for Southern Company (2005)
- "Comparison of MM5- and RUC-Based Meteorological Input Fields for REMSAD Mercury Modeling", (with S. Douglas, S. Beckmann, and T. Myers), memo prepared for EPA Office of Water (2005)
- "Characterization of Meteorology and Its Relationships to Fine Particulate Mass and Visibility in the VISTAS Region, Methods Report", (with S. Douglas and S. Beckmann), prepared for VISTAS (2005)
- "Evaluation of a Homology Mapping Technique in Estimating Particulate Matter Concentrations for the SEARCH Sites", (with S. Douglas and S. Beckmann), Memo prepared for Southern Company (2005)
- "Assessment of the Meteorological Representativeness of 2000–2004 for Four SEARCH Areas", (with S. Douglas and S. Beckmann), Memo prepared for Southern Company (2005)
- Analysis of the Potential Frequency of Impact of Southern Company Power Plant Emissions on the SEARCH Monitoring Sites," (with S. Douglas), Memo prepared for Southern Company (2005).
- "Conceptual Description for 8-Hour Ozone for the Memphis Metropolitan Area", (with S. Douglas, S. Beckmann, and J. Haney), Draft Report prepared for ADEQ (2005)
- "Development of a PM2.5 Forecasting Tool for Allegheny County, Pennsylvania", (with S. Douglas and S. Beckmann), Technical Memo prepared for the Mid-Atlantic Regional Air Management Association (MARAMA), (2005)
- "Analysis of Similarities and Differences in the Causes of High Ozone between the Knoxville and Great Smoky Mountains National Park Monitoring Sites", (with S. Douglas, J. Haney, and S. Beckmann), memo prepared for Tennessee DEC and Knox County Dept. of Air Quality Management, (2005)
- "CDM Early Action Compact Ozone Modeling Analysis for the Shreveport-Bossier City Metropolitan Area" (with S. Douglas, Y. Wei, J. Mangahas, A. Alvarez, G. Glass, S. Hartley, and J. Haney), SYSAPP-04-013, prepared for CDM (2004)
- "SESARM Early Action Compact Ozone Modeling Analysis for the State of Tennessee and Adjacent Areas of Arkansas and Mississippi" (with S. Douglas, Y. Wei, J. Mangahas, A. Alvarez, G. Glass, S. Hartley, and J. Haney), SYSAPP-04-012, prepared for Southeast States Air Resource Managers (SESARM) (2004)
- "Conceptual Description of 8-Hour Ozone in the Pensacola Area and Along the Florida Panhandle" (with S. Douglas, J. Mangahas, Y. Wei, and J. Haney), SYSAPP-04-003, prepared for Florida Department of Environmental Protection (2004)
- "West Florida Ozone Study (WFOS) Data Analysis and Modeling Study" (with J. Haney, S. Douglas, Y. Wei, A. Alvarez, S. Hartley, G. Glass and J. Mangahas), SYSAPP-03-020, prepared for Florida Department of Environmental Protection (2004)
- "Application of Regional-Scale Modeling to 8-Hour Ozone Attainment Demonstrations" (with S. Douglas, J. Mangahas, and A. Alvarez), SYSAPP-03-052, prepared for U.S. EPA, Office of Air Quality Planning and Standards (OAQPS) (2003)
- "CART Analysis of Wet and Dry Deposition for Three Locations in Wisconsin" (with S. Douglas and T. Myers), SYSAPP-03-015, prepared for U.S. EPA, Office of Water (2003)
- "Application of the UAM-V Modeling System for the Analysis of an 8-Hour Ozone Episode for South Carolina" (with S. Douglas, A. Alvarez, J. Mangahas, and J. Haney), SYSAPP-02-114, prepared for the South Carolina Department of Health and Environmental Control (2002)

- "Application of the REMSAD Modeling System to Estimate the Deposition of Nitrogen and Mercury" (with T. Myers, Y. H. Wei, G. Glass, and J. Mangahas), SYS-APP-02-101, prepared for U.S. Environmental Protection Agency (2002)
- "Ozone Episode Selection Analysis for Pensacola, Florida (1996-2001)" (with J. Mangahas, S. Douglas, G. Glass, and J. Haney), SYSAPP-02-090, prepared for the Florida Department of Environmental Protection (2002)
- "Ozone Episode Selection Analysis for Urban Areas in Northern Georgia and Northern Alabama (1995-2001)" (with S. Douglas, G. Glass, and A. Alvarez), SYSAPP-02-049, prepared for Southern Company (2002)
- "CO Dispersion Model Feasibility Study: Fairbanks and Anchorage, Alaska" (with S. Douglas, M. Saeger, J. Haney, Y. H. Wei, G. Glass, and R. Beizaie), SYSAPP-02-044, prepared for the State of Alaska Department of Environmental Conservation (2002)
- "1-Hour Ozone Attainment Demonstration Modeling for Baton Rouge" (with S. Douglas, Y. H. Wei, A. Alvarez, R. Beizaie, and J. Haney), SYSAPP-01-066, prepared for the Louisiana Department of Environmental Quality (2001).
- "Gulf Coast Ozone Study (GCOS) Modeling Analysis: Phase II Methods and Results" (with S. Douglas, Y. H. Wei, A. Alvarez, R. Beizaie, and J. Haney), SYSAPP-01-049, prepared for the States of Florida, Alabama, Mississippi, and Louisiana and Southern Company (2001).
- "Development and Implementation of A Homology Mapping Technique to Aid the Selection of Cities for Modeling of the Effects of Urban Heat Island Mitigation Measures on Ozone Air Quality" (with S. Douglas and J. R. Lundgren), SYSAPP-01-008, prepared for the Global Programs Division, U.S. Environmental Protection Agency (2001)
- "Meteorological and Air Quality Modeling to Further Examine the Effects of Urban Heat Island Mitigation Measures on Several Cities in the Northeastern U.S." (with S. Douglas and J. R. Lundgren), SYSAPP-01-001, prepared for the Global Programs Division, U.S. Environmental Protection Agency (2001)
- "Air Quality Modeling to Examine the Effects of Urban Heat Island Mitigation Measures on Several Cities in the Northeastern U.S." (with S. G. Douglas), SYSAPP-20/03r1, prepared for the Climate Protection Division, U.S. Environmental Protection Agency (2000)
- "Preparation of Non-Emissions-Related Inputs for Application of the UAM-V Modeling System to the Western U.S." (with S. G. Douglas and A. R. Alvarez), SYSAPP-99/31, prepared for the Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency (1999)
- "Regional Carbon Monoxide Dispersion Modeling for the Spokane Serious Nonattainment Area Plan" (with S. G. Douglas and A. R. Alvarez), SYSAPP-99/22r1, prepared for Spokane County Air Pollution Authority (1999)
- "Frequency of Impact of Georgia Power Facilities on Ozone Exceedances in the Atlanta Area" (with S. G. Douglas), SYSAPP-99/20, prepared for Southern Company Services (1999)
- "Episode Selection Analysis for 1-Hour and 8-Hour Ozone for Potential Nonattainment Areas in Northern Georgia and Alabama" (with S. G. Douglas and A. R. Alvarez), SYSAPP-99/12, prepared for Southern Company Services (1999)
- "Development and Pilot Application of Air Quality Indicators" (with A. S. Rosenbaum and J. P. Cohen), SYSAPP-98/19, prepared for the Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency (1998)
- "Development of UAM-V Inputs for Seasonal Applications" (with G. E. Mansell), SYSAPP-97/56, prepared for Pacific Environmental Services, Inc. (1997)
- "NAAQS Analysis Support. Task 1: Episode Selection" (with S. G. Douglas), SYSAPP-97/55, prepared for Pacific Environmental Services, Inc. (1997)
- "NAAQS Analysis Support. Task 2: Model Performance" (with S. G. Douglas and S. T. Malkin), SYSAPP-97/53, prepared for Pacific Environmental Services, Inc. (1997)
- "NAAQS Analysis Support. Task 3: Early Assessment" (with S. G. Douglas and S. T. Malkin), SYSAPP-97/42, prepared for Pacific Environmental Services, Inc. (1997)
- "Identification of Candidate Ozone Episodes for Photochemical Modeling of the Birmingham Area Considering Both a One-Hour and an Eight-Hour Standard" (with S. G. Douglas), SYSAPP-97/24d, prepared for Southern Company Services (1997)

- "Identification of Candidate Ozone Episodes for Photochemical Modeling of the Atlanta Area Considering Both a One-Hour and an Eight-hour Standard," (with S. G. Douglas), SYSAPP-97/21d, prepared for Southern Company Services (1997)
- "Classification of Ozone Episodes for Four Southern Cities According to Transport Characteristics" (with S. G. Douglas), SYSAPP-97/03, prepared for Southern Company Services (1997)
- "Analysis of Southern California Wind Profiler and Aircraft Data (with S. G. Douglas, N. K. Lolk, and Z. T. Guo), SYSAPP-97-95/091r3, prepared for the California Air Resources Board (1997)
- "Comparison of MOCA Coarse-Grid and Full Nested-Grid UAM-V Simulated Ozone Concentrations for 4-11 July 1988" (with S. G. Douglas), SYSAPP-96/077, prepared for Southern Company Services (1996)
- "UAM Modeling Analysis of the Clark County/Las Vegas Valley Area" (with co-workers), SYSAPP-96/03, prepared for the Clark County Department of Comprehensive Planning (1996)
- "UAM Ozone Modeling Workshop for Clark County Department of Comprehensive Planning" (with S. G. Douglas and J. L. Haney), SYSAPP-95/044, prepared for the Clark County Department of Comprehensive Planning (1995)
- "Application of the Urban Airshed Model to Baton Rouge, Louisiana for Three Additional Multi-Day Ozone Episodes. Volume I: UAM Input Preparation" (with S. G. Douglas and J. L. Haney), SYSAPP-95/077d, prepared for Louisiana Department of Environmental Quality (1995)
- "Application of the Urban Airshed Model to Baton Rouge, Louisiana for Three Additional Multi-Day Ozone Episodes. Volume III: Diagnostic/Sensitivity Analysis and Model Performance Evaluation (with S. G. Douglas and J. L. Haney), SYSAPP-95/079, prepared for Louisiana Department of Environmental Quality (1995)
- "UAM Modeling Analysis of the Cincinnati-Hamilton Multistate Moderate Ozone Nonattainment Area" (with S. G. Douglas, M. M. Jimenez, J. L. Fieber, and J. L. Haney), SYSAPP-95/059, prepared for Pacific Environmental Services, Inc., and the U.S. Environmental Protection Agency (1995)
- "Intersection Air Quality Modeling: Review of Ambient Data and Current Modeling Practices. Volume 1: Analysis of Historical CO Data" (with T. E. Stoeckenius, A. S. Rosenbaum, and R. G. Ireson), SYSAPP-93/152, prepared for National Transportation Research Board, National Research Council (1994)
- "Comparison of the UAM-IV and UAM-V Photochemical Models for Three Atlanta-Area Ozone Episodes" (with others), SYSAPP-94/106, prepared for Atlanta UAM-IV/UAM-V Comparison Technical Work Group, Georgia Environmental Protection Division, EPA Region IV, Southern Company Services, Georgia Power Company, and Georgia Institute of Technology (1994)
- "Photochemical Modeling of the Maricopa County Ozone Nonattainment Area" (with others), SYSAPP-94/079, prepared for Maricopa Association of Governments, Phoenix, Arizona (1994)
- "Preparation of Alternative Mixing-Height and Wind Fields for UAM Modeling of the 19B21 July 1987 North Carolina Ozone Episode" (with S. G. Douglas), SYSAPP-94/042, prepared for Duke Power Company, Huntersville, North Carolina (1994)
- "City of Coronado Third and Fourth Street Corridor Air Quality Study" (with others), SYSAPP-94-93/084, prepared for City of Coronado, California (1994)
- "UAM Modeling Analysis of the Cincinnati-Hamilton Multi-State Moderate Ozone Nonattainment Area: UAM Input Preparation" (with others), SYSAPP-93/028, prepared for Pacific Environmental Services, Inc. and U.S. Environmental Protection Agency (1993)
- "UAM Modeling Analysis of the Huntington-Ashland Multi-State Moderate Ozone Nonattainment Area: UAM Input Preparation" (with others), SYSAPP-93/027, prepared for Pacific Environmental Services, Inc. and U.S. Environmental Protection Agency (1993)
- "Estimates of Future Exposures of Exercising Asthmatics to Short-Term Elevated SO<sub>2</sub> Concentrations Resulting from Emissions of U.S. Fossil-Fueled Power Plants: Effects of the 1990 Amendments to the Clean Air Act and a 5-minute Average Ambient SO<sub>2</sub> Standard" (with co-workers), SYSAPP-92/016, prepared for Utility Air Regulatory Group (1992)
- "AB-2588 Health Risk Assessment for ARCO Product's West Sacramento Tank Terminal" (with co-workers), SYSAPP-92/013, prepared for Yolo-Solano County Air Pollution Control District (1992)

- "Modeling Protocol to Conduct Health Risk Assessment for (Confidential Client)" (with B. Garelick, L. C. Freeman, Y. H. Wei, and M. Easter) SYSAPP-92/090, prepared for Confidential Client (1992)
- "AB 2588 Health Risk Assessment" (with B. Garelick, L. C. Freeman, Y. H. Wei, and M. Easter), SYSAPP-92/103, prepared for Confidential Client (1992)
- "Modeling Analysis to Predict 1-Hour Ambient SO<sub>2</sub> Concentrations for Ashland St. Paul Park Refinery" (with K. O'Connor and Y. H. Wei), prepared for Ashland Oil Inc. (1992)
- "Estimates of Future Exposures of Exercising Asthmatics to Short-Term Elevated SO<sub>2</sub> Concentrations Resulting from Emissions of U.S. Fossil-Fueled Power Plants: Effects of the 1990 Amendments to the Clean Air Act" (with co-workers), SYSAPP-91/143, prepared for Utility Air Regulatory Group (1991)
- "Verification of NYSDEC's 17 July 1991 Emission Inventory for Inter-Power's PSD Permit Application for the Halfmoon Cogeneration Plant. Volume I. Technical Report" (with co-workers), SYSAPP-91/128a, prepared for Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency (1991)
- "Carbon Monoxide Air Quality Modeling of the Phoenix Metropolitan Area in Support of the Federal Implementation Plan" (with co-workers), SYSAPP-91/111, prepared for Region IX Office, U.S. Environmental Protection Agency (1991)
- "Modeling Protocol to Conduct BIF Analysis for Southdown Fairborn Cement Kiln" (with co-workers), SYSAPP-91/093, prepared for Southdown Inc. (1991)
- "AB-2588 Health Risk Assessment for Unocal's Los Angeles Refinery" (with co-workers), SYSAPP-91/076, prepared for Unocal Corporation (1991)
- "A Multivariate Data Analysis Technique for Assessing the Influence of Meteorological Conditions on Ozone Concentration Trends" (with T. E. Stoeckenius), SYSAPP-91/043, prepared for Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency (1991)
- "Modeling Protocol for ARCO Placerita Canyon Health Risk Assessment" (with co-workers), SYSAPP-91/029, prepared for South Coast Air Quality Management District (1991)
- "Improved Procedures for Quantifying Key Meteorological Effects on Ambient Ozone Data" (with T. E. Stoeckenius, C. Daly, and A. M. Noda), SYSAPP-91/082, prepared for California Air Resources Board (1991)
- "Modeling Protocol to Conduct Health Risk Assessment for Unocal Los Angeles Refinery" (with co-workers), SYSAPP-91/042, prepared for Unocal Refining and Marketing Division, Wilmington, California (1991)
- "Dispersion Modeling for Estimating PAH Exposure from Aluminum Smelter Operations in the Tacoma, Washington Area" (with R. G. Ireson), SYSAPP-90/081, prepared for Kaiser Aluminum and Chemical Corporation (1991)
- "Modeling and Risk Assessment for ARCO's Derby Acres Facility" (with others), SYSAPP-91/032, prepared for ARCO Oil and Gas, submitted to Kern County Air Pollution Control District (1991)
- "Modeling Protocol for ARCO's Tejon Pumping Station Health Risk Assessment" (with others), SYSAPP-91/019, prepared for ARCO Transportation, submitted to Kern County Air Pollution Control District (1991)
- "Adjustment of Ozone Trends for Meteorological Variation" (with T. E. Stoeckenius), SYSAPP-90/008, prepared for Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency (1990)
- "Analysis of Area-Wide Carbon Monoxide Emissions and Concentrations" (with others), SYSAPP-90/058, prepared for Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency (1990)
- "Analysis of Contributions to PM<sub>10</sub> Concentrations During Episodic Conditions" (with H. A. Gray and R. G. Ireson), SYSAPP-90/072, prepared for Kaiser Aluminum and Chemical Corporation (1990)
- "City Descriptions for 15-City Trends" (with L. A. Mahoney and P. Sullivan), SYSAPP-90/025, prepared for Office of Air Quality Planning and Standards, U.S. EPA (1990)
- "Improved Procedures for Quantifying Key Meteorological Effects on Ambient Ozone Data: Pilot Analysis" (with others), SYSAPP-90/030, prepared for California Air Resources Board (1990)

- "Color Handbook of Visible Plumes and Haze Layer" (with others), SYSAPP-89/039, prepared for Western Energy Supply and Transmission Associates (1989)
- "Modeling of the Ozone-Forming Potential of Precursor Emissions in Port Valdez, Alaska" (with G. E. Anderson), SYSAPP-89/006, prepared for CH2M Hill (1989)
- "Ozone Modeling Study for Port Valdez Alaska. Volume II: Modeling of the Ozone-Forming Potential of Precursor Emissions in Port Valdez, Alaska" (with G. E. Anderson), SYSAPP-89/029, prepared for CH2M Hill (1989)
- "Analysis of Variability of UAPSP Precipitation Chemistry Measurements. Volume I: Main Report" (with A. K. Pollack and T. S. Stocking), SYSAPP-89/104a, prepared for Utility Acid Precipitation Study Program, Washington, D.C., and Electric Power Research Institute, Palo Alto, California (1989)
- "Review of Selected Portions of MMS' Proposed Air Quality Regulations for OCS Sources (17 January 1989 *Federal Register*)" (with others), SYSAPP-89/061, prepared for State of California, Department of Justice (1989)
- "Statistical Properties of Hourly Concentrations of Volatile Organic Compounds at Baton Rouge, Louisiana" (with A. K. Pollack), SYSAPP-89/037, prepared for U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1989)
- "The Environmental Protection Agency Interim Data Base for Air Toxic Volatile Organic Chemicals" (with others), SYSAPP-88/154, prepared for the U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1988)
- "Center for Environmental Physics and Chemistry Data: Requirements and Specifications" (with others), SYSAPP-86/162, prepared for Electric Power Research Institute, Palo Alto, California (1987)
- "Default Values for Coal Sulfur Content for Small Sources" (with S. C. Grosser, T. J. Permutt, and L. R. Chinkin), SYSAPP-87/184, prepared for the U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1987)
- "Development of Computer Modules of Particulate Processes for the Regional Particulate Model" (with P. Saxena and C. Seigneur), SYSAPP-87/084, prepared for the U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1987)
- "The Data Base Management System for the EPRI Plume Model Validation Study. Volume II. User's Manual" (with J. Ames and T. C. Myers), SYSAPP-86/117, prepared for the Electric Power Research Institute, Palo Alto, California (1986)
- "User's Manual for the PLMSTAR.SCE Model" (with C. Seigneur), SYSAPP-86-077, prepared for Southern California Edison, Rosemead, California (1986)
- "Further Development and Application of a Mathematical Model of Sulfate and Nitrate Formation in Plumes" (with C. Seigneur and P. Saxena), SYSAPP-86/028, prepared for Southern California Edison, Rosemead, California (1986)
- "An Examination of 1982-1983 Particulate Matter Ratios and Their Use in the Estimation of PM10 NAAQS Attainment Status" (with A. K. Pollack and A. D. Thrall), SYSAPP-85/115, prepared for the U.S. Environmental Protection Agency (1985)
- "Temporal and Spatial Variability of the Visual Effects of Stack Plumes" (with C. Seigneur and H. Hogo), SYSAPP-84/209, EPA-600/3-85/039, prepared for the U.S. Environmental Protection Agency (1985)
- "Mathematical Modeling of the Concentration, Chemical Composition, and Size Distribution of Aerosols in Plumes" (with C. Seigneur and P. Saxena), SYSAPP-85/026, prepared for Southern California Edison (1985)
- "Simulation of the Regional Air Quality Impact of Industrial Emission Controls" (with C. Seigneur), SYSAPP-84/148, prepared for the U.S. Environmental Protection Agency (1984)
- "Further Development and Application of the PLMSTAR Trajectory Model" (with C. Seigneur, P. Saxena, P. M. Roth, and K. J. Tran), SYSAPP-84/017, prepared for Southern California Edison (1984)
- "User's Manual for the PLMSTAR III Model" (with C. Seigneur), SYSAPP-84/064, prepared for Southern California Edison (1984)
- "Summaries of TSP, Ammonium, Nitrate, S. Sulfate, Data Measured at the Kincaid Site" (with M. C. Dudik and S. D. Reynolds), SYSAPP-83/012, prepared for the Electric Power Research Institute (1983)
- "Diagnostic Validation of Plume Models at a Plains Site," SYSAPP-83/002, prepared for the Electric Power Research Institute (1983)

- "Coal-Fired Power Plant Contribution to Visibility Impairment in Western Pristine Areas, VISTTA 1979 Interim Report, Part 2: Case Studies for Plume Visibility Model Evaluation" (with Meteorology Research, Inc.), prepared for the U.S. Environmental Protection Agency (1982)
- "Visual Impacts in Integral Vistas—Projections for Selected Development Scenarios," SYSAPP-82/132, prepared for the National Park Service (1982)
- "Air Quality and Meteorology of Northwestern New Mexico," SYSAPP-82/014, prepared for Arizona Public Service (1982)
- "Evaluation of a Single-Scattering Formula," SYSAPP-82/124, prepared for the U.S. Environmental Protection Agency (1982)
- "Evaluation of the EPA PLUVUE and the ERT Visibility Models Based on the 1979 VISTTA Data Base," EPA-450/4-82-008, prepared for the U.S. Environmental Protection Agency (1982)
- "A Catalog of Data for the EPRI Plume Model Validation Data Base: Kincaid Site" (with S. D. Reynolds), SYSAPP-82/272, prepared for the Electric Power Research Institute (1982)
- "Source Emissions and Plume Characterization: Measurements, Analysis, and Modeling of the Visual Effects of the Navajo Generating Station Plume" (with C. Seigneur and R. W. Bergstrom), SYSAPP-82/040, prepared for Salt River Project (1981)

## EMPLOYMENT HISTORY

Systems Applications International/ICF International	Senior Atmospheric Scientist	1980–present
California Air Resources Board	Senior Scientist, Staff Scientist Technical Assistant	1979–1980

## Boddu N. Venkatesh

## ICF International

### EDUCATION

M.B.A. Level Courses in Finance & Financial Risk Management, Virginia Polytechnic Institute and State University, Falls Church, Virginia, 1999-2000  
Ph.D., Systems Engineering, Case Western Reserve University, Cleveland, Ohio, 1996  
Ph.D. Student in Energy Management and Policy Program, University of Pennsylvania, Philadelphia, Pennsylvania, 1992 – 1993  
Master of Science in Systems Engineering, Case Western Reserve University, Cleveland, Ohio, 1992  
B. Tech, Electrical and Electronics Engineering, Jawaharlal Nehru Technological University, Hyderabad, India, 1989

### EXPERIENCE

Dr. Venkatesh is currently a Principal at ICF Consulting Incorporated. He is a versatile systems engineer with strong analytical and computer skills. He has good knowledge of applying systems and operations research tools to complex problems. Energy and environmental analyses have been his area of focus. At ICF Consulting, Dr. Venkatesh has been primarily involved with supporting U.S. EPA, Environment Canada, RPO's and other clients with IPM® based analytical work in regards to electric sector environmental compliance planning for NO<sub>x</sub>, SO<sub>2</sub>, CO<sub>2</sub> and Mercury. He has also managed the Environmental Assessment for the FERC Order 2000. Dr. Venkatesh has in the past helped evaluate the value of power plant assets and was the lead analyst involved in developing the ICF Consulting's Bulk Power Outlook 1999. He has developed methodologies for incorporating industrial boilers and advanced emission-banking structures into IPM.

His Ph.D. dissertation research focused on developing decision and risk methodologies and simulation models for explicitly incorporating uncertainty into long-term investment planning decisions. Cogeneration plant modeling was his MS Thesis. He has expanded his financial expertise by taking several courses in Finance and Financial Risk Management at Virginia Tech.

### TECHNICAL EXPERTISE

- Risk & Decision Analysis
- Energy/ Mathematical Modeling
- Financial Analyses
- Air Emission Analyses
- Power Market Analyses

### EXPERIENCE

#### Modeling and Environmental Analyses

U.S. EPA Base Case. Dr. Venkatesh has contributed to and/or managed the scoping, development and implementation of the U.S. EPA's view regarding the power sector in the United States since 1996. This view is summarized in the IPM based US EPA's 1996, 1998 and versions 2.1, 2.1.5, 2.1.5b, 2.1.6 and 2.1.9 Base Cases. These projects also involve the development/updating of the IPM, IPM-Front-End Processing Tool, Parsing Tool and the ORL file generation tool. In addition to the updating of the assumptions, the latest market view regarding the electric sector was incorporated.

RPO's. Dr. Venkatesh has managed the development of future unit level emission inventories using IPM for VISTAS, LADCO, CENRAP and MARAMA. These projects involve updating of IPM's underlying data as per comments from VISTAS, CENRAP, MANE-VU and MRPO member organizations and then modeling various IPM policy scenarios.

US EPA Rulemakings. Dr. Venkatesh has managed ICF Consulting's support to US EPA in its analysis and development of CAIR, CAMR, CAVR, Section 316 (b), and SIP Call rulemakings.

Clear Skies Act. Dr. Venkatesh has provided model based analytical support to US EPA in its analysis and development of the Clear Skies Act.

Analysis of Power Sector Air Emission Regulatory Proposals. Dr. Venkatesh has managed several multi-pollutant air emissions analyses for the U.S. power sector. These analyses focused on analyzing various proposals such as the Clean Air Initiative, Pallone Bill, Voinovich Bill, Jeffords-Lieberman Bill and a variety of sensitivity analysis around these and other proposals, using IPM. The air emissions analyzed include SO<sub>2</sub>, NO<sub>x</sub>, Mercury and CO<sub>2</sub>.

U.S.-Canada Emissions Trading Feasibility Study. For Environment Canada, Dr. Venkatesh has managed the development of an implementation of IPM, with the capability to analyze Canadian power and air emission markets. This project also involves the integration of the Canadian and the U.S. power and air emission market characteristics into an integrated IPM Base Case to facilitate analyzing the combined U.S.-Canada Power and Air Emission Markets. This framework is supporting the U.S.-Canada Emissions Trading Feasibility Study.

Environment Canada MERS. Dr. Venkatesh has supported Environment Canada in its analysis of the impact of multipollutant policies on Alberta, Saskatchewan, Ontario, Nova Scotia and New Brunswick provinces, using IPM.

FERC RTO NOPR (FERC Order 2000). Dr. Venkatesh has managed the work regarding the environmental assessment of the FERC RTO NOPR. This project involved several steps including framing of the problem, scenario development and quantification of the impacts of the RTO NOPR on the environment using IPM.

American Electric Power Air Emissions Study. Dr. Venkatesh has helped manage the Air Emissions Study for the American Electric Power's proposed 745 KV transmission line, using IPM.

Ozone Transport Rulemaking / Section 126 Regulatory Analysis. Dr. Venkatesh managed the analysis supporting Section 126 and NO<sub>x</sub> Sipcall rulemakings. He performed or managed several runs for studying the economic impact of NO<sub>x</sub> regulation on the electric utility industry. He also supported U.S. EPA by contributing to its Regulatory Impact Assessment for this rule. (January-May, 1999)

Ozone Transport Assessment Group. Dr. Venkatesh performed most of the NO<sub>x</sub> emissions focused analyses to support U.S. EPA's Proposed Ozone Transport Rulemaking Regulatory Analysis. In addition, Dr. Venkatesh used ICF Consulting's IPM model to implement and analyze the impacts of several multi-zone trading and single zone trading NO<sub>x</sub> emission reduction proposals on the electric utility industry for Ozone Transport Assessment Group (OTAG).

National Ambient Air Quality Standard. Dr. Venkatesh used ICF Consulting's IPM model to help analyze the impacts of several SO<sub>2</sub> emission reduction policies on the U.S. electric utility industry for achieving U.S. EPA's National Ambient Air Quality Standard (NAAQS) target. The United States regional SO<sub>2</sub> strategy was an output of the effort. (January-March, 1997)

IPM and Global Climate Change. Dr. Venkatesh developed a draft methodology for enhancing IPM to help it to perform climate change related analyses for the time horizon 2000-2050. In addition, he has analyzed several CO<sub>2</sub> emission reduction policies to support U.S. EPA in analyzing the U.S. Draft Protocol Framework and co-control benefits for the Climate Inter-Agency Team. The analysis will include the efficacy of banking and borrowing policies on the total cost of compliance. (April 1997)

Clean Air Power Initiative. Dr. Venkatesh used ICF Consulting's IPM model to analyze the impacts of several NO<sub>x</sub> and SO<sub>2</sub> emission reduction policies on the U.S. electric utility industry for U.S. EPA's Clean Air Power Initiative (CAPI). (April-July, 1996)

Electric Utility Sector CO<sub>2</sub> Emissions. Dr. Venkatesh has performed a model-based estimation of carbon taxes required to stabilize the U.S. electric sector carbon emissions. He modified the coal supply curve spreadsheet to incorporate the impact of carbon taxes on the coal supply curves. He wrote several memorandums for documenting the model and the results obtained from the analysis. (April-December, 1996)

### **Industrial Boilers and Cogeneration Plants**

Cogeneration Potential in New York. Dr. Venkatesh has managed a study for NYSERDA for estimating the cogeneration potential in the State of New York. (December, 2000 – 2003)

Industrial Boilers and Cogeneration Plants. Dr. Venkatesh has developed a modeling methodology to incorporate industrial boilers and cogeneration plants into IPM. This included developing and documenting the required mathematical model. This enhancement will help estimate the CO<sub>2</sub> and other pollutant emissions from the industrial sector. (August-September, 1996)

## SELECTED PRESENTATIONS AND CONTRIBUTIONS TO REPORTS

- Venkatesh, B.N. et al. 2000. The Particulate Related Health Benefits of Reducing Power Plant Emissions.
- Venkatesh, B.N. et al. 2000. AEP Air Emissions Study.
- Venkatesh, B.N. 2000. Power Transmission and Air Emissions. Presented at the 21<sup>st</sup> Annual North American Conference of the USAEE/IAEE, Philadelphia, PA. September 24-27, 2000.
- Venkatesh, B.N. 2000. Integrated Planning Model. Presented at the Energy Modeling Forum – 17, Working Group Meeting, Stanford, CA. June 1-2, 2000.
- Venkatesh, B.N. 2000. Overview of an Integrated Approach to Emission Policy Analysis. Presented for U.S. EPA, Fairfax, VA. April 14, 2000.

## PUBLICATIONS

- Linville, C.D., B.F. Hobbs and B.N. Venkatesh. 2000. Estimation of Error and Bias in Bayesian Monte Carlo Decision Analysis Using the Bootstrap. Risk Analysis, 21(1), Feb. 2001, 63-74
- Venkatesh, B.N. and Hobbs, B.F. 1999. Analyzing Investments for Managing Lake Erie Levels under Climate Change Uncertainty, Water Resources Research. 35(5):1671-1683
- Venkatesh, B.N. and Vira Chankong. 1995. Decision Models For Management of Cogeneration Plants, IEEE Transactions on Power Systems. 10(3):1250-1256
- Venkatesh, B.N. 1996. Analyzing Investments under Climate Change Uncertainty: Management of Levels of the Great Lakes. Ph.D. Dissertation. CWRU.
- Hobbs, B.F., P.T. Chao and B.N. Venkatesh. 1997. Using Risk Analysis to Include Climate Change in Water Resources Decision Making. Climatic Change.
- Chao, P.T., B.N. Venkatesh and Hobbs, B.F. Is Climate Change Relevant to Water Investment Decisions: Decision Analysis, Presented at Informs Conference on Analysis to Support Public Sector Decision Making, Washington D.C., May 5-8, 1996.
- Chao, P.T., B.F. Hobbs and B.N. Venkatesh. 1999. How Climate Uncertainty should be Included in Great Lakes Management: Modeling Workshop Results. Journal of American Water Resources Association, 35(6):1485-1497.
- Venkatesh, B.N. 1992. Decision Models for Operating and Planning Cogeneration Plants: Case Study from NASA LeRC. M.S. Thesis. CWRU.

## EMPLOYMENT HISTORY

ICF Consulting Inc.	Principal	1996 - Present
Case Western Reserve University	Research Assistant	1993 - 1996
University of Pennsylvania	Research Assistant	1992 - 1993
Case Western Reserve University	Graduate Assistant	1991 - 1992
Steel Authority of India	Junior Manager	1989 - 1990

## Timothy Lavallee, P.E.

### Senior Environmental Engineer / Air-Quality and Noise Specialist

#### EDUCATION

B.S. Mechanical Engineering, 1992, Northeastern University, Boston, MA  
M.S. Civil and Environmental Engineering, 1997, Tufts University, Medford, MA

#### PROFESSIONAL REGISTRATION

Registered Professional Engineer, Commonwealth of Virginia and State of Maryland

#### PROFESSIONAL ORGANIZATIONS

- Society of American Military Engineers, Member
- American Society of Civil Engineers, Member
- Acoustical Society of America, Member and Regional Chairman
- Institute of Noise Control Engineering, Member

#### QUALIFICATIONS

Timothy Lavallee is well qualified as an air-quality and noise specialist with more than a decade of experience in the environmental and transportation fields. Mr. Lavallee has managed or been directly involved in a number of environmental and transportation related projects, including Environmental Assessments (EA), Environmental Impact Statements (EIS), transportation modeling and prediction, transportation noise prediction and impact. Mr. Lavallee is well versed in the NEPA process, air quality, hazardous waste, regulatory compliance and environmental noise assessment.

In addition to his core competencies, Mr. Lavallee is proficient in many areas of computer science and information technologies, including computer programming, data reduction and analysis, GIS (ARCVIEW/ARCInfo), and document and graphics production. Mr. Lavallee previously worked for Lockheed Martin at the National Aeronautics and Space Administration's (NASA) Langley Research Center in flight test support and environmental noise reduction. Before this he worked at Logan International Airport, Boston, MA for the Massachusetts Port Authority's environmental planning branch.

#### Selected Areas of Interest and Expertise

- Environmental Noise Prediction and Impact Assessment
- Air Quality Analysis
- Environmental Planning
- Environmental Compliance, particularly at and around airports
- NEPA Document Preparation

#### AIR-QUALITY AND NOISE ASSESSMENT EXPERIENCE

Mr. Lavallee has been directly involved in or oversaw the development of the many environmental and transportation planning documents. As well as overall project management, Mr. Lavallee traditionally performs the air-quality, noise, hydrological, traffic and land use assessment. Recent projects include:

- Fort Lee and Fort A.P. Hill BRAC EIS (2006)- Realignment
- Fort Belvoir BRAC EIS and Conformity Determination (2006)- Realignment
- Fort Sill BRAC Environmental Assessment (2006) - Realignment
- Fort Monmouth BRAC Environmental Assessment - Closure
- Air and Noise Sections for the FERC NE-07 Pipeline Project EIS including verifying and incorporating resource report number 9 several pipeline component projects, including:

- The Millennium Pipeline Project;
- Empire Connector Project;
- Algonquin Ramapo Expansion Project; and the
- Iroquois Market Expansion Project.

The overall project included the establishment and modification of several compressor stations. A technical review of the air emissions calculation, draft air permits, sound surveys, future noise estimations and regulatory review was performed.

- Camp Bowie Multipurpose Machine Gun Range (2005) Environmental Assessment
- Buckley AFB Annex (2005) Environmental Assessment and Conformity Determination
- Runnels Federal Building (2005) Supplemental EA
- National Army Museum (2005) Environmental Assessment and Conformity Determination
- ROTHRA Radar Timber Harvest (2005) Environmental Assessment and Conformity Determination
- Pier D Replacement (2005) Environmental Assessment and Conformity Determination
- DCEETA Remote Delivery Facility (2005) Environmental Assessment and Conformity Determination
- Beulah Street Realignment, Environmental Assessment, Fort Belvoir, VA
- DCEETA Remote Delivery Facility, Environmental Assessment, Fort Belvoir, VA
- Rehabilitation of the Chamberlin Hotel Environmental Assessment, Fort Monroe, VA
- Relocation SDDC Headquarters, Environmental Assessment, Fort Eustis, VA
- Fort Sam Gate Closure EA, San Antonio, TX
- Space Utilization EA, Andrews AFB, MD
- Fire Training Facility EA, Andrews AFB, MD
- Pope C-130J Beddown EA, Pope AFB, NC
- Buckley IMRMP EA, Buckley AFB, CO
- Buckley AFB Fire Fighting Training Facility EA, Buckley AFB, Colorado
- Buckley AFB H70 Storage Facility EA, Buckley AFB, CO
- Buckley AFB Entomology Facility EA, Buckley AFB, CO
- Buckley AFB HWSF EA, Buckley AFB, Colorado
- Buckley AFB Landscape Design, Buckley AFB, Colorado
- Buckley AFB Consolidated Fuels, Buckley AFB, Colorado
- Buckley AFB Recreational Facility, Buckley AFB, Colorado
- GSA Austin Federal Courthouse EA, Austin, TX.
- Lane Addition for Lockhill Selma EA, San Antonio, TX
- Westmoreland Road Lane Closure, CATEx, Dallas, TX
- Fort Hancock Point of Entry EA, Fort Hancock TX
- DFW International Commerce Park EA, Dallas TX
- Immigration Naturalization Service Triple Fence EIS, Fort Worth, TX.
- El Paso Courthouse Annex EA, El Paso, TX

- Little Rock Courthouse Annex EA, Little Rock, AK
- FBI Building Construction EA, Dallas, TX
- GSA San Antonio Federal Courthouse EA, San Antonio, TX

Rehabilitation of the Chamberlin Hotel Environmental Assessment, Fort Monroe, VA. Mr. Lavalley developed the draft air-quality and noise analysis for the environmental assessment of the proposed renovation of the Chamberlin Hotel to convert it to a military retirement community, with an assisted living facility and parking deck. This analysis included a regulatory analysis, a review of existing information for the project corridor, an analysis of the impacts of the proposed action and no-action alternative and associated mitigation measures. Emission calculations for an applicability analysis were performed to determine if the general conformity rule applied. Records of non-applicability (RONA) and appropriated calculations were also provided.

Relocation SDDC Headquarters, Environmental Assessment, Fort Eustis, VA. Mr. Lavalley developed the final air-quality analysis for the proposed construction and operation of a 22-acre facility for temporary accommodation of Surface Deployment and Distribution Command Headquarters. Emission calculations for an applicability analysis were performed to determine if the general conformity rule applied. Emissions due to off-road construction equipment were included in the analysis. Air-quality impacts, primarily increased CO emissions, associated with increase traffic at near-by roadways were addressed.

Beulah Street Realignment, Environmental Assessment, Fort Belvoir, VA. Mr. Lavalley developed the air-quality analysis for the proposed relocation a 0.5-mile section of Beulah Street between Snyder Road and Telegraph Road in the North Area of Fort Belvoir. This analysis included several alternative actions.

DCEETA Remote Delivery Facility, Environmental Assessment, Fort Belvoir, VA. Mr. Lavalley developed the air-quality, noise and traffic section for the proposed construction and operation of a 30-acre remote delivery facility and associated road network at Fort Belvoir.

Fort Sam Gate Closure EA, San Antonio, TX. Mr. Lavalley developed the air-quality and noise analysis for the proposed gate closure environmental assessment at Fort Sam, Houston. The bulk of the work addressed construction and traffic and preparing sections for the existing conditions and the four alternatives. Modeling of construction and traffic noise and potential emissions were key aspects of this effort.

## PUBLICATIONS

- Digital Identification of Intrusive Noise in Soundscapes Acoustical Society of America May 2005, Vancouver, BC (*In Prep/Invited*)
- Natural and Urban Soundscapes: The need for multi-disciplined research Acoustical Society of America November 2004, San Diego, CA, (*Invited*)
- Prediction of Aircraft Flight Tracks From Noise Measurements, Acoustical Society of America December 2001, Ft. Lauderdale Florida, (*Invited*)
- Acoustically Triggered Infrared Video Monitoring Unit, Acoustical Society of America, December 2000 Newport Beach California
- Wind Tunnel Data Acquisition and Analysis System, Users Manual II - System Software, Information Report 98-DF19-16, Lockheed Space Missions and Support Service, Inc. 1999
- Wind Tunnel Data Acquisition and Analysis System, Users Manual I - System Hardware, Information Report 98-DF19-16, Lockheed Space Missions And Support Services, Inc. 1999
- Airframe Noise Test - Data Encryption Display and Look-Up System (DAEDALUS) – Users Manual, Information Report 98-DF05-10, Lockheed Martin Science and Engineering Company, Inc. 1999
- Wind Tunnel Data Acquisition and Analysis System, Users Manual I, Information Report 98-DF19-16, Lockheed Martin Science and Engineering Company, Inc. 1998

- Airframe Noise Test - Data Analysis Procedures, Information Report 98-DF05-10, Lockheed Martin Science and Engineering Company, Inc. 1998
- Design and Use of Microphone Directional Arrays for Aeroacoustic Measurements, AIAA 98-0471, 1998
- Flap Edge Aeroacoustic Measurements and Predictions AIAA 2000-1975 1998
- Evaluation of RCRA Part B Exemptions and Impact to Innovative Technologies EPA Region I, Office of Environmental Stewardship and Tufts University 1997

#### **AWARDS**

- Merit Award, National Aeronautics and Space Administration (NASA), 'Turning Goals into Reality' (TIGR) for work on the Environmental Noise and Civil Tilt Rotor Transport projects at NASA Langley 1998
- Individual Achievement Award, Lockheed Martin Space Support and Sciences, Inc. for work on the Airframe Noise Reduction Project at NASA Langley Research Center 1997

**Diane E. Shotynski**

**THRUPUT—Virginia DMBE Certified Woman Owned Business Enterprise (No. 661584)**

**EDUCATION**

Bachelor of Science in Civil Engineering, University of Pennsylvania, Philadelphia, PA 1980

**EXPERIENCE**

**Department of Environmental Quality, Abingdon, VA**

Air permitting—Wrote permits for new and stationary sources of air pollution for sources in Southwest Virginia, such as fuel-burning equipment, quarrying operations, coal preparation plants and various coating operations from 1993 to 1995.

**Chester Engineering, Towson, MD**

Worked as an engineer during environmental remediation of an industrial site in Baltimore, MD. Also, involved in various phases of remediation of a contaminated site (creosote) on the Eastern Shore of Maryland. Duties included some field investigations and review of EPA comments of the chemical analyses of the groundwater during pretreatment in 1991.

**Dynamac Corporation, Gaithersburg, MD**

Prepared reports and cost estimates of remediation projects on DOD bases throughout the country. Also contributed to analyses of alternative treatment methods for 2 Remedial Action Plans (RAP) or Phase IIA of the DOD CERCLA Program. Most importantly assisted in the upkeep of a CERCLA Program Database, (in Dbase) which kept the status of remedial action projects throughout the country from 1986 through 1988.

**City of Philadelphia Air Management Services, Philadelphia, PA**

Evaluated criteria & toxic air emissions from stationary sources located in the city. Modeled toxic pollutant emissions for Right To Know regulation. Inspected facilities, verifying permit parameters of equipment and material usage. Sources varied from coating operations to metal fabricators. 1980-1986

**CERTIFICATION**

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